



SNS COLLEGE OF TECHNOLOGY

Coimbatore – 35

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

19ECT311 / Wireless Communication

III ECE/ VI SEMESTER

Unit II - **MOBILE RADIO PROPAGATION**

Topic 9 : Small Scale fading- Types



Factors Influencing

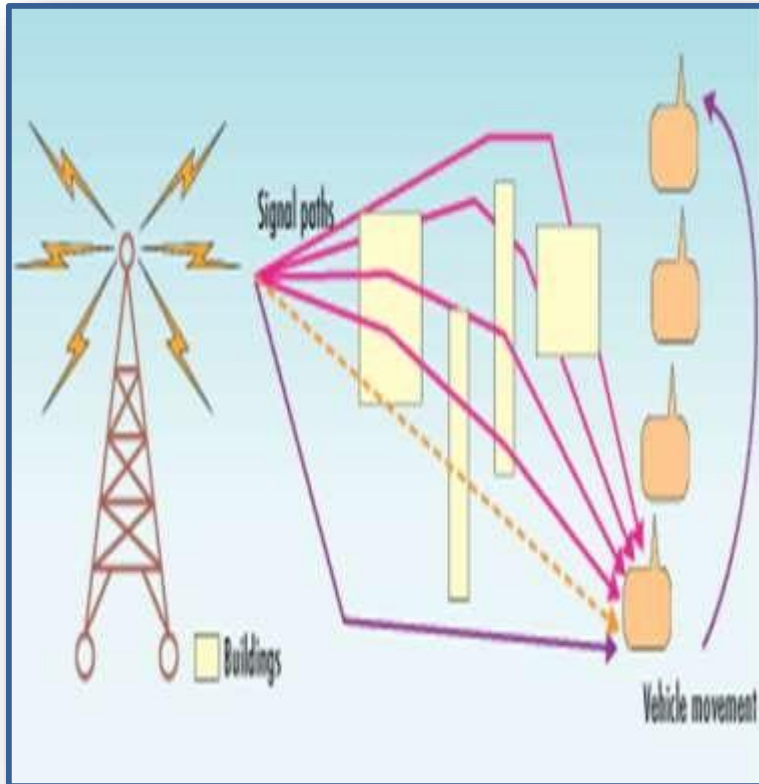
Factors influencing small-scale fading

- Multipath propagation: reflection objects and scatters
- Speed of the mobile: Doppler shifts
- Speed of surrounding objects
- Transmission bandwidth of the signal





Multipath fading

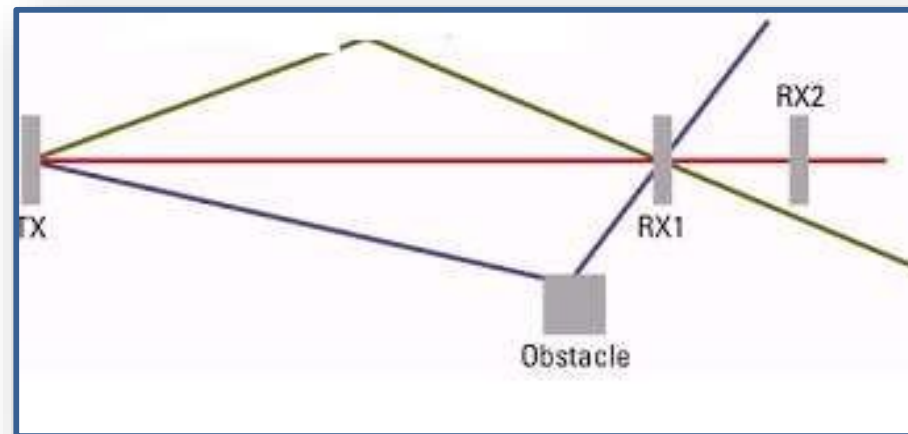


- **Fading** is variation of the attenuation of a signal with various variables
- These variables include **time, geographical position, and radio frequency**
- Fading is often modelled as a **random process**
- When a signal takes multiple paths from transmitter to receiver due to obstacles in the path, it is called **Multipath fading**



Types

Small scale fading(Based on Multipath time delay spread)



Multipath Time delay Spread



Based on Multipath time delay spread

Flat fading:

- The mobile radio channel has
 1. Bandwidth of the Signal $<$ Bandwidth of the channel

Frequency selective fading:

- The mobile radio channel has
 1. Bandwidth of the Signal $>$ Bandwidth of the channel





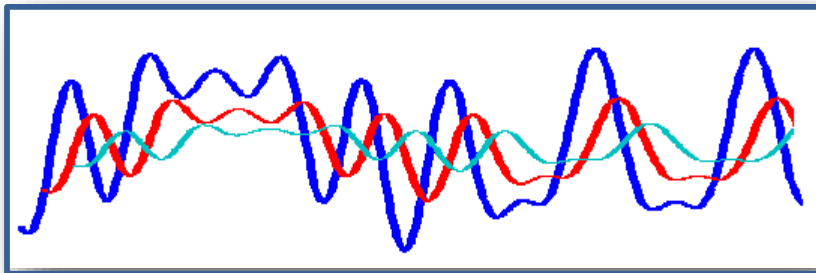
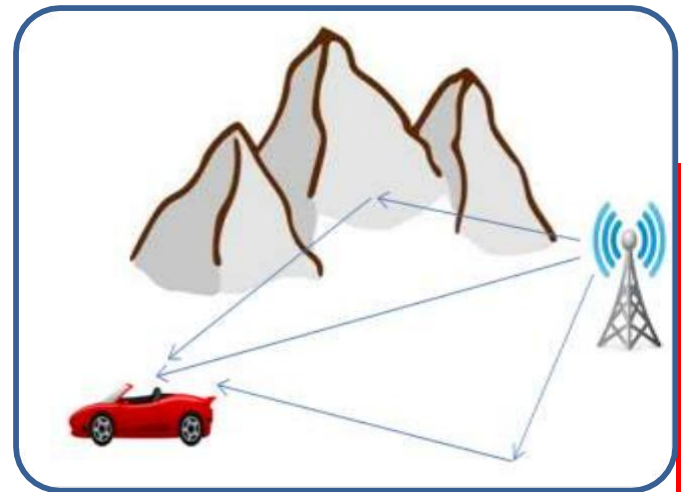
Based on Multipath time delay spread

Flat fading:

- The mobile radio channel has
 1. Doppler Spread $<$ Symbol Period

Frequency selective fading:

- The mobile radio channel has
 1. Doppler Spread $>$ Symbol Period



Symbol Period

Doppler spread



ACTIVITY



Activity: Draw a logo which may describe your character or things you like.



Flat fading

- The wireless channel is said to be flat fading if it has constant gain and linear phase response over a bandwidth which **is greater** than the bandwidth of the transmitted signal
- All the frequency components of the received signal fluctuate in **same** proportions simultaneously
- It is also known as non-selective fading
 - **Signal BW \ll Channel BW**
 - **Symbol period \gg Delay Spread**
- The effect of flat fading is seen as decrease in SNR
- These flat fading channels are known as amplitude varying channels or narrowband channels



Frequency Selective fading

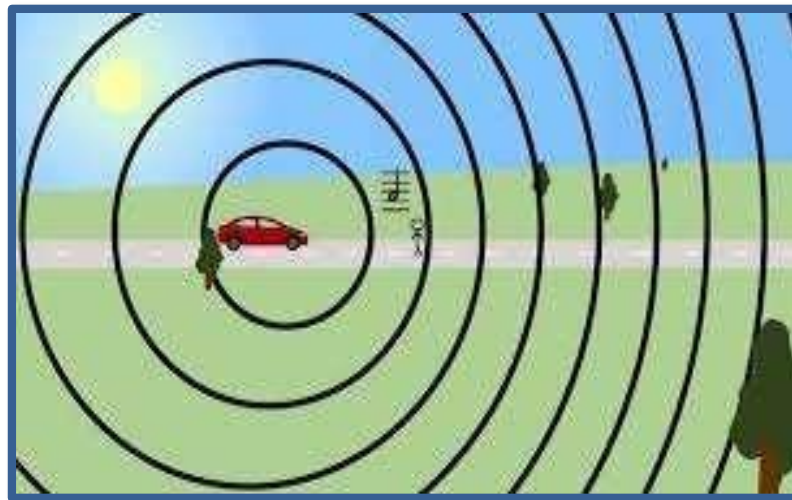


- If the channel possesses a constant-gain and linear phase response over a bandwidth that is **smaller** than the bandwidth of transmitted signal, then the channel creates frequency selective fading on the received signal
- It affects different spectral components of a radio signal with **different** amplitudes. Hence the name selective fading
 - **Signal BW > Channel BW**
 - **Symbol period < Delay Spread**
- The received signal includes multiple versions of the transmitted waveform which are attenuated (faded) and delayed in time, and hence the received signal is distorted
- Frequency selective fading channels are much more difficult to model



Types

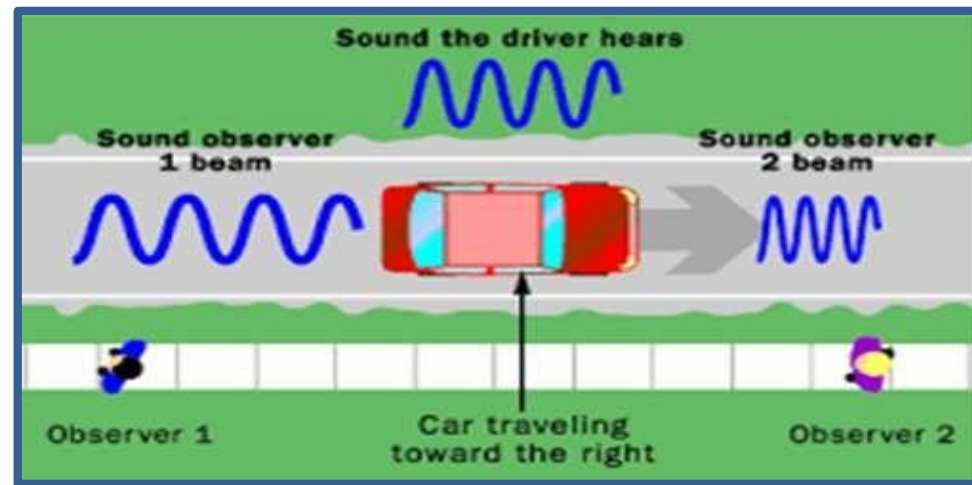
Small scale fading(Based on Doppler spread)





Based on Doppler Spread

- **Fast Fading:**
 1. High Doppler Spread
- **Slow Fading:**
 1. Low Doppler Spread





Fast Fading

- In a fast fading channel, the coherence time of the channel is **smaller** than the symbol period of the transmitted signal
- This causes frequency dispersion due to Doppler spreading, which leads to **signal distortion**
- Viewed in the frequency domain, signal distortion due to fast fading increases with increasing Doppler spread relative to the bandwidth of the transmitted signal
- Therefore, a signal undergoes fast fading if

$$T_s > T_c$$

$$B_s < B_D$$



Slow Fading

- In a slow fading channel, the channel impulse response changes at a rate much slower than the transmitted baseband signal $s(t)$.
- In this case, the channel may be assumed to be static over one or several reciprocal bandwidth intervals.
- In the frequency domain, this implies that the Doppler spread of the channel is much less than the bandwidth of the baseband signal.
- Therefore, a signal undergoes slow fading if

$$T_s \gg T_c$$

$$B_s \ll B_D$$



Assessment



- **Small scale propagation model is also known as _____**
 - a. Fading model
 - b. Micro scale propagation model
 - c. Okumura model
 - d. Hata model
- **Flat fading or frequency nonselective fading is a type of _____**
 - a. Multipath delay spread small scale fading
 - b. Doppler spread small scale fading
 - c. Both a) and b)
 - d. None of the above
- **Types of small scale fading, based on Doppler spread are _____**
 - a. Fast fading
 - b. Frequency nonselective fading
 - c. Flat fading
 - d. Frequency selective fading





Thank you