SNS COLLEGE OF TECHNOLOGY

Coimbatore – 35

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

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

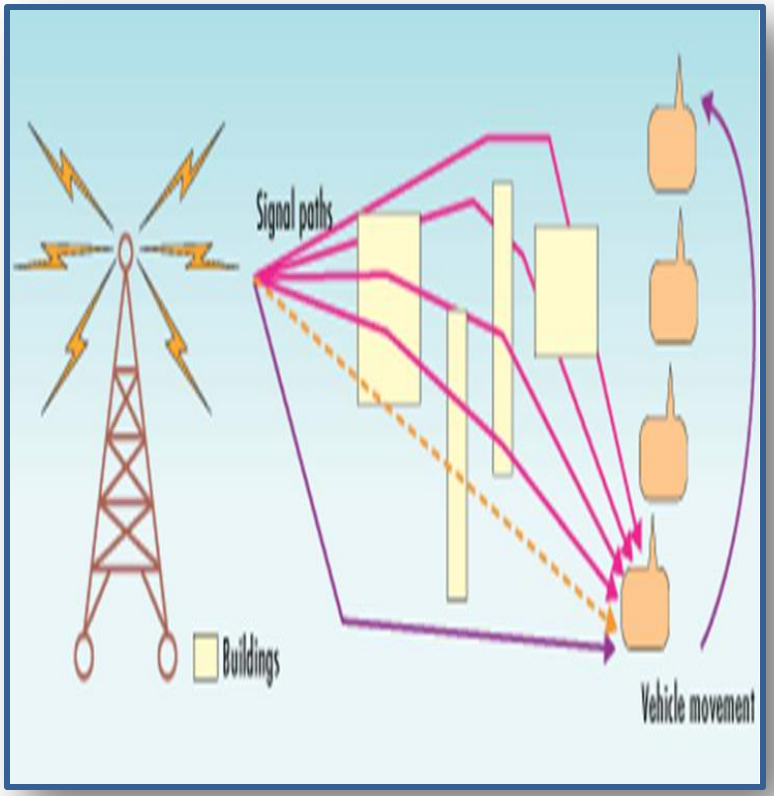
– Multipath propagation: reflection objects and scatters

– Speed of the mobile: Doppler shifts

– Speed of surrounding objects

– Transmission bandwidth of the signal

Multipath fading

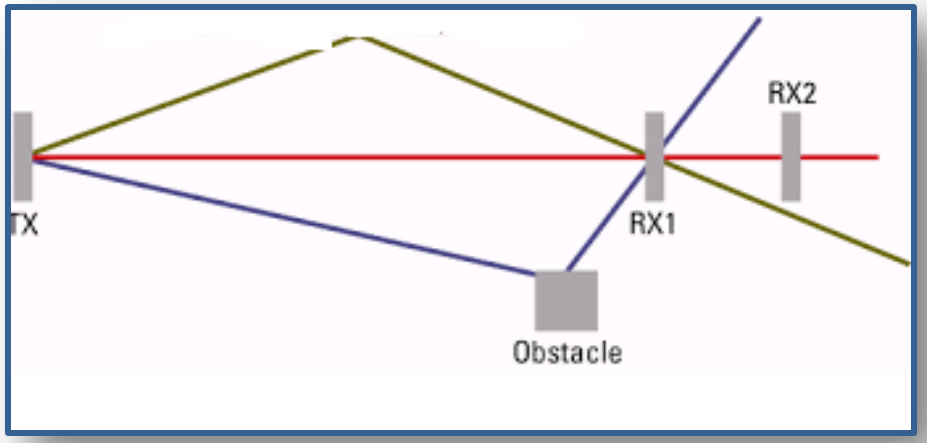


- **Fading** is variation of the attenuation of a signal with various variables
- These variables include **time, geographical position, and radio frequency**
- Fading is often modelled as a **random process**
- When a signal takes multiple paths from transmitter to receiver due to obstacles in the path,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

Types

Small scale fading(Based on Multipath time delay spread)

- Flat Fading
- Frequency Selective fading



Multipath Time delay Spread

Based on Multipath time delay spread

Flat fading:

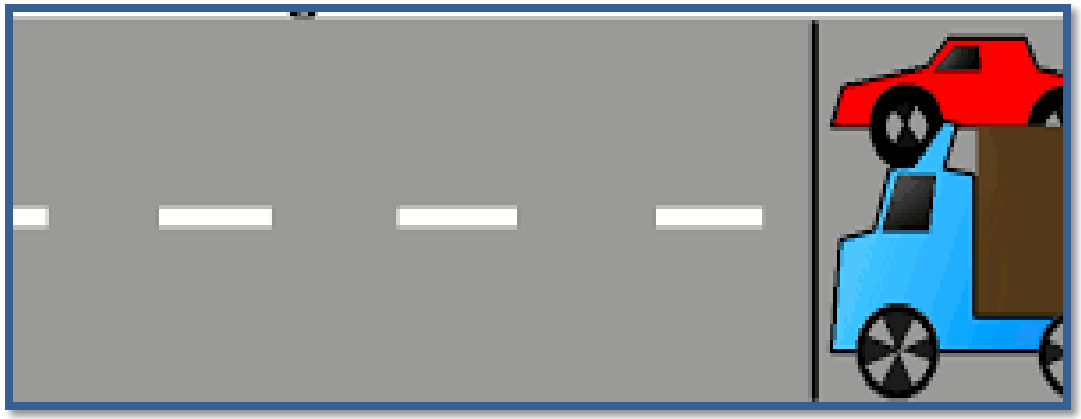
- The mobile radio channel has

  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:

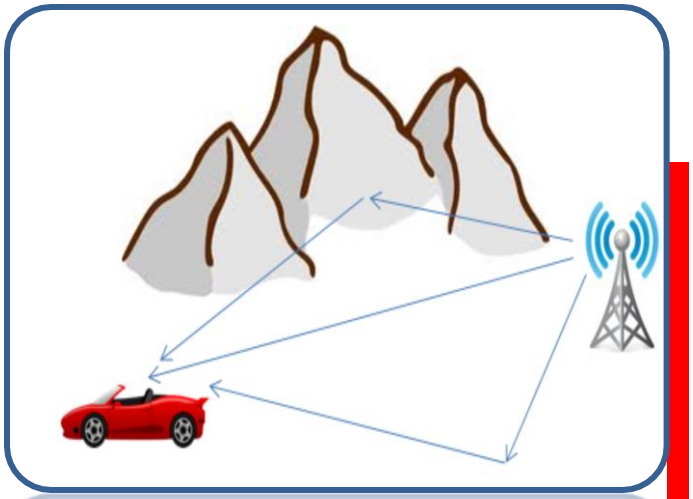
- The mobile radio channel has

  1. Doppler Spread < Symbol Period

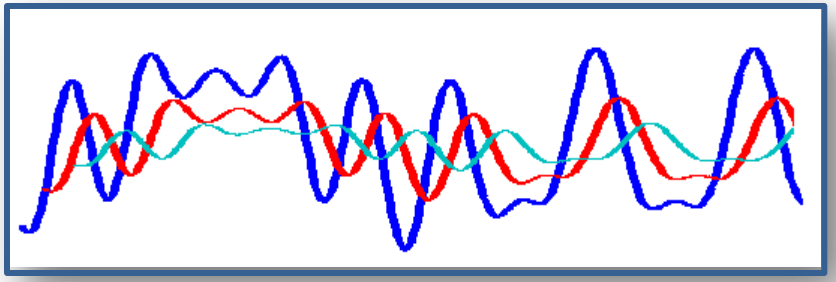
Frequency selective fading:

- The mobile radio channel has

  1. Doppler Spread > Symbol Period



Doppler spread



Symbol Period

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 << Channel BW
  • Symbol period >> 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

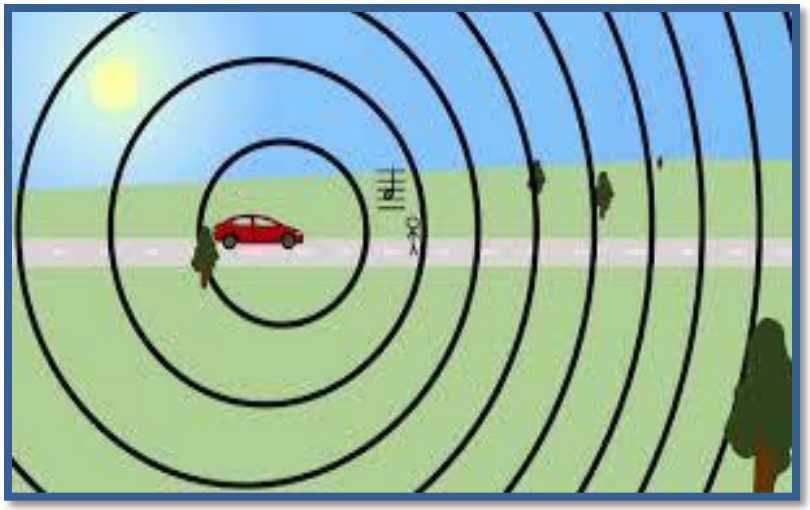
- The received signal includes multiple versions of the transmitted waveform which are attenuated (faded) and delayed in time, and hence the received signal is distorted
- Frequency selective fading channels are much more difficult to model

Types

Small scale fading(Based on Doppler spread)

Fast Fading

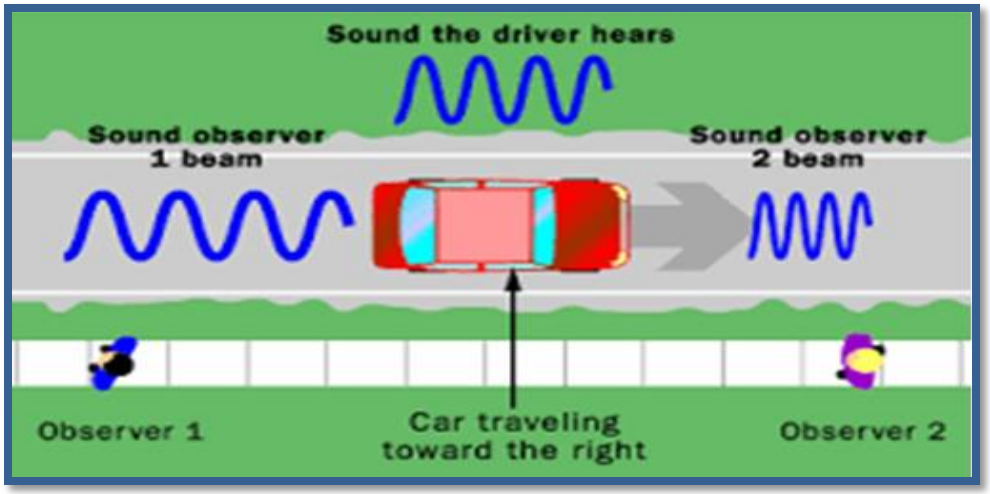
Slow fading



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

$$T_S >> T_C$$

$$B_S << B_D$$

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 non selective fading

  c. Flat fading

  d. Frequency selective fading

Thank you