

Mobile Radio Propagation Large-Scale Path Loss

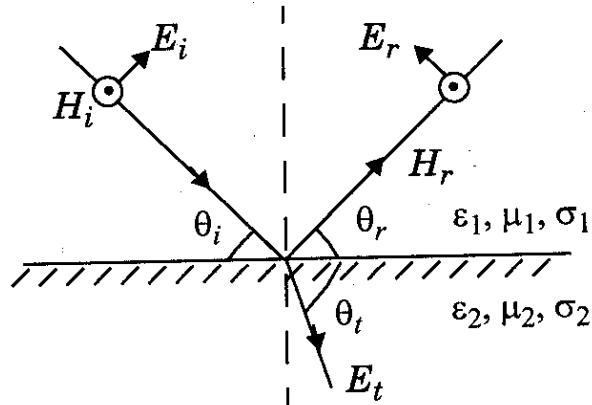
Unit-1

3.4 The Three Basic Propagation Mechanisms

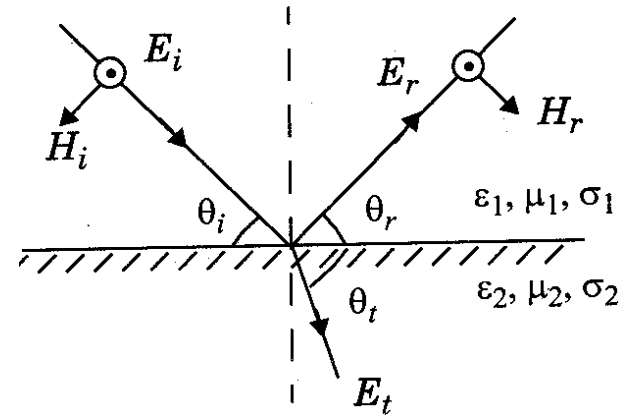
- Basic propagation mechanisms
 - reflection
 - diffraction
 - scattering

- Reflection occurs when a propagating electromagnetic wave impinges upon an object which has very large dimensions when compared to the wavelength, e.g., buildings, walls.
- Diffraction occurs when the radio path between the transmitter and receiver is obstructed by a surface that has sharp edges.
- Scattering occurs when the medium through which the wave travels consists of objects with dimensions that are small compared to the wavelength.

- Reflection from dielectrics



E-field in the plane of incidence



E-field normal to plane of incidence

- Reflection from perfect conductors

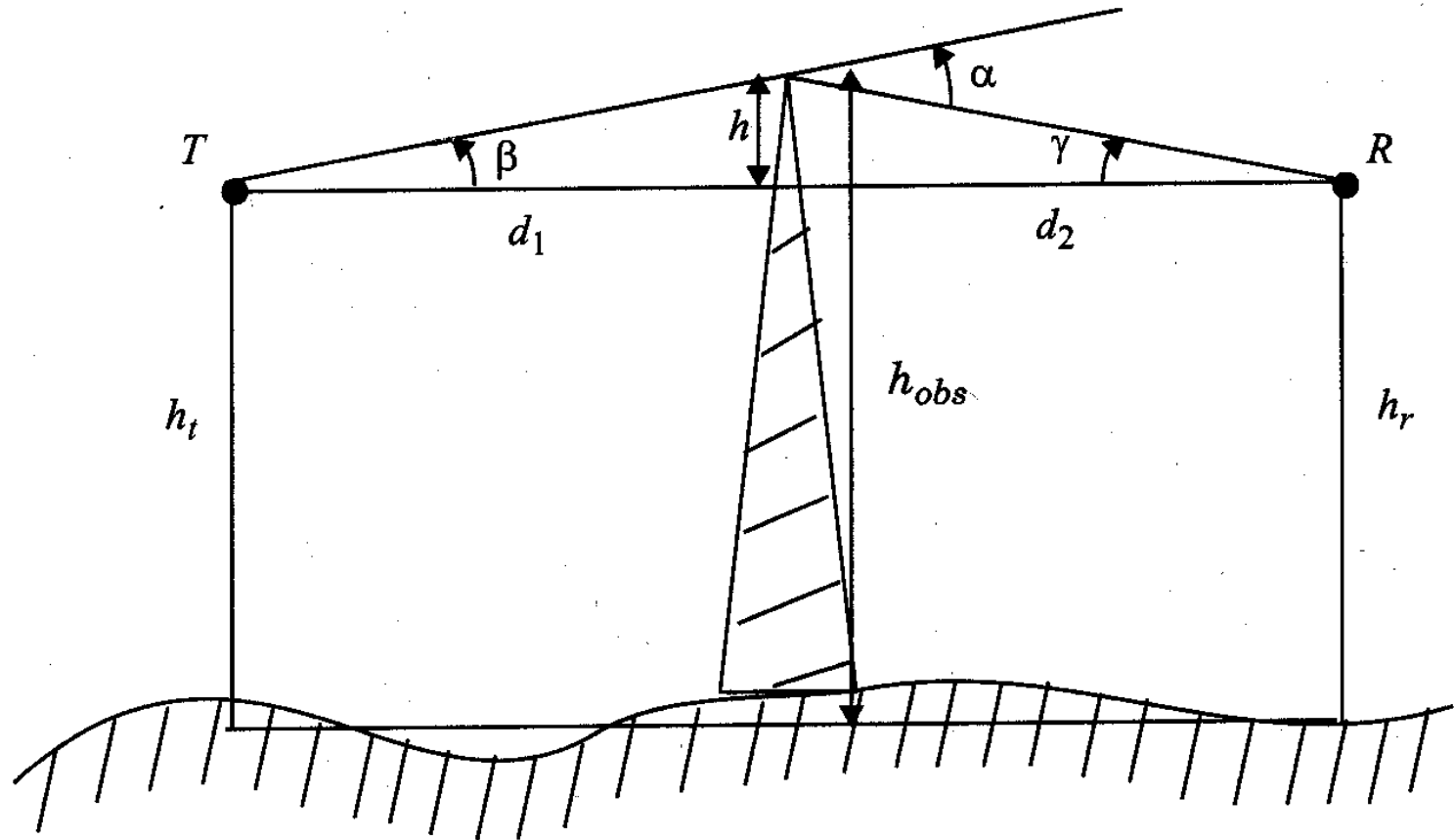
- E-field in the plane of incidence

$$\theta_i = \theta_r \quad \text{and} \quad E_i = E_r$$

- E-field normal to the plane of incidence

$$\theta_i = \theta_r \quad \text{and} \quad E_i = -E_r$$

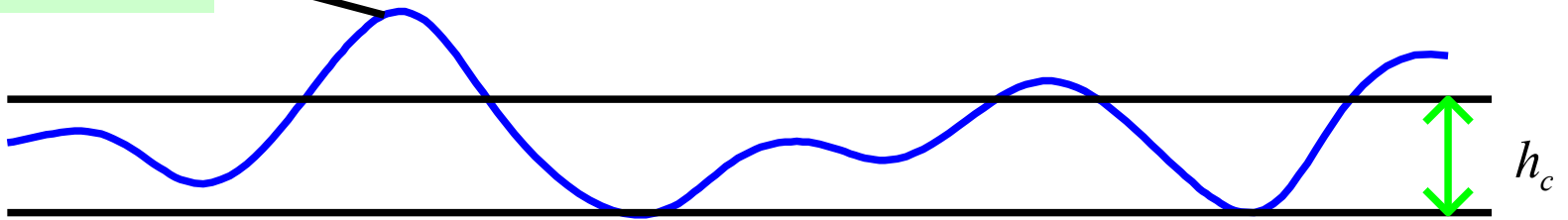
- Diffraction



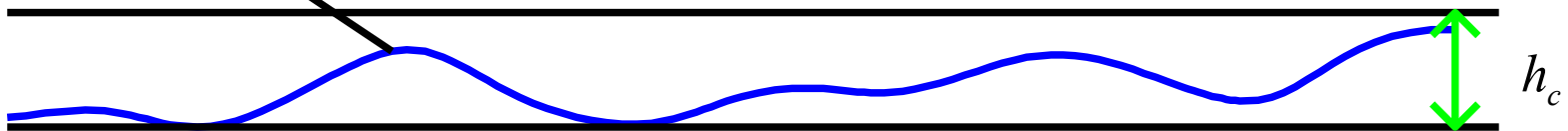
- The actual received signal is often stronger than what is predicted by reflection and diffraction
- Scattering
 - when a radio wave impinges on a rough surface, the reflected energy is spread out, e.g., trees, lamp posts.
- Surface roughness is test using Rayleigh criterion which defines a critical height h_c for a given angle of incidence θ_i

$$h_c = \frac{\lambda}{8 \sin \theta_i}$$

rough surface



smooth surface



- For rough surface, the flat surface reflection coefficient needs to be multiplied by a scattering loss factor

$$\rho_s = \exp \left[\left(\frac{\pi \sigma_h \sin \theta_i}{\lambda} \right)^2 \right]$$

σ_h is the standard deviation of the surface height.