SNS COLLEGE OF TECHNOLOGY

Coimbatore – 35

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

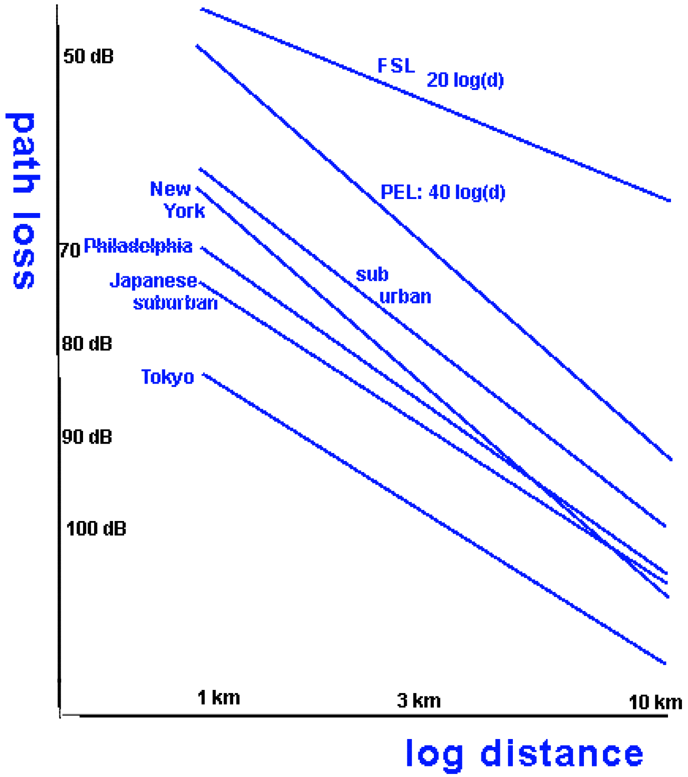
19ECT311 / Wireless Communication

III ECE/ VI SEMESTER

Unit II **- MOBILE RADIO PROPAGATION**

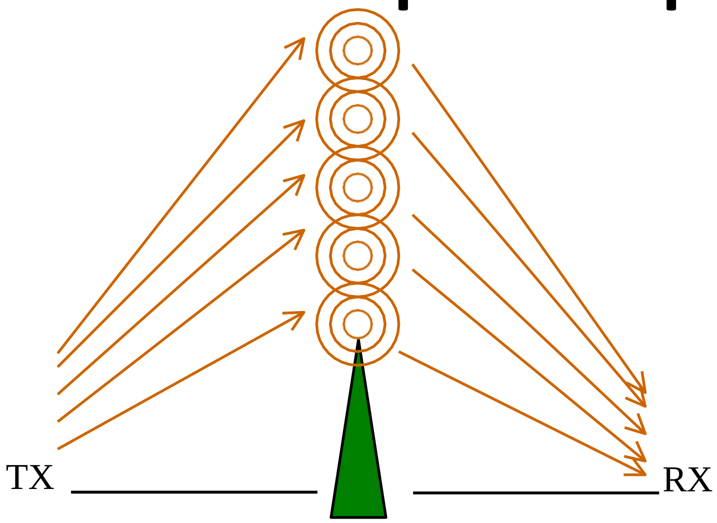
Topic 4: Diffraction

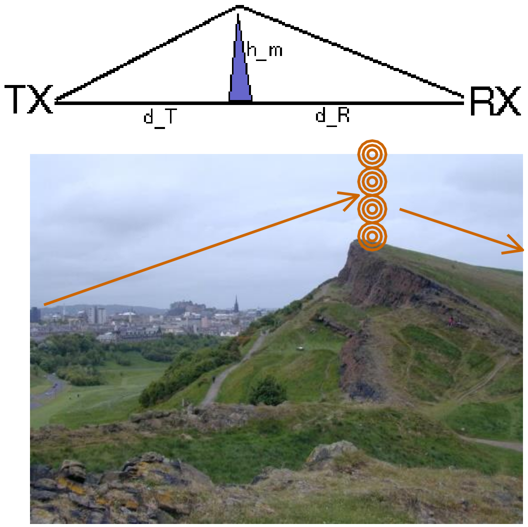
Path Loss versus Distance



Calculate

Diffraction loss: Huygens principle



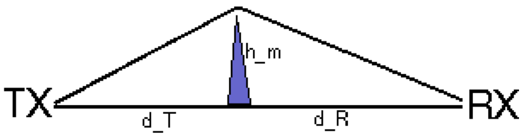


h_m is the height of the obstacle, and

d_t is distance transmitter - obstacle

d_r is distance receiver - obstacle

Diffraction loss



The diffraction parameter *v* is defined as

$$v = h_m \sqrt{\frac{2}{\lambda}\left(\frac{1}{d_t} + \frac{1}{d_r}\right)},$$

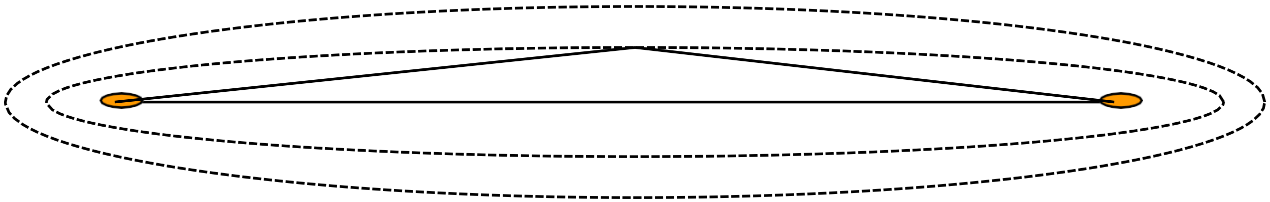
where

h_m is the height of the obstacle, and

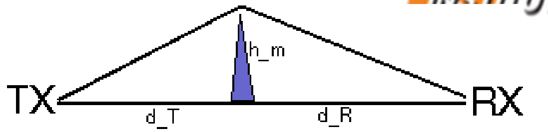
d_t is distance transmitter - obstacle

d_r is distance receiver - obstacle

Fresnel zone: ellipsoid at which the excess path length is constant (e.g. $\lambda/2$)



Diffraction loss



The diffraction parameter *v*

$$v = h_m \sqrt{\frac{2}{\lambda}\left(\frac{1}{d_t} + \frac{1}{d_r}\right)},$$

The diffraction loss L_d, expressed in dB, is approximated by

$$L_d = \begin{cases} 6 + 9v - 1.27v^2 & 0 < v < 2.4 \\ 13 + 20\log v & v > 2.4 \end{cases}$$

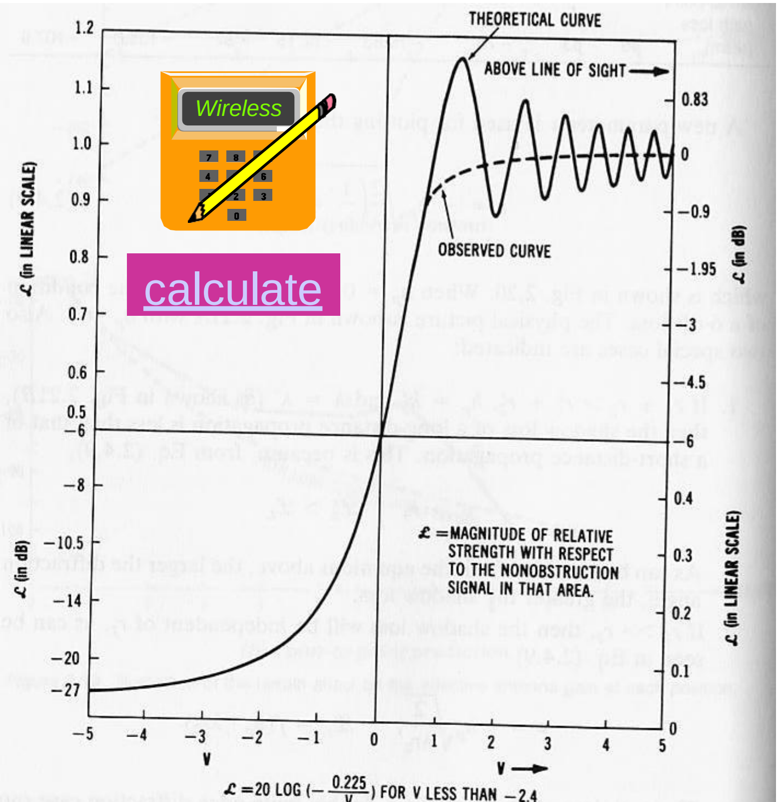


Figure 2.20. Shadow-loss prediction.

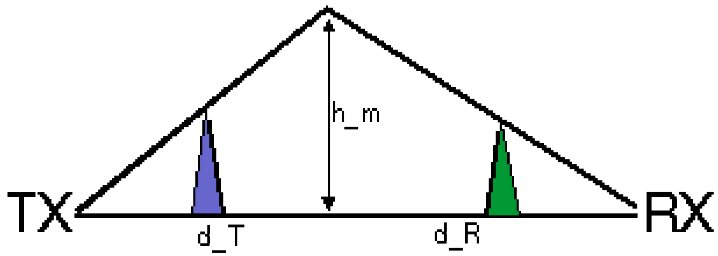
ACTIVITY

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

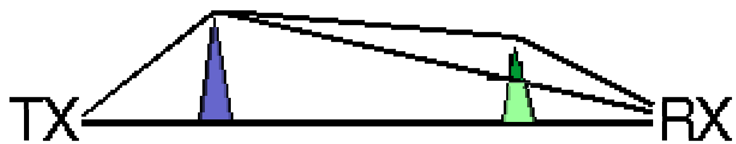
Multiple knife edges

How to model multiple hills?

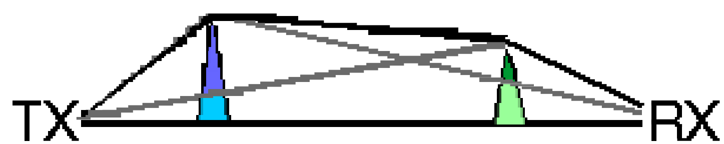
Bullington



Deygout



Epstein



Typical terrain

Propagation models consider a full terrain profile

- multiple knife edges or rounded edges
- groundreflections

Micro-cellular models

Statistical Model

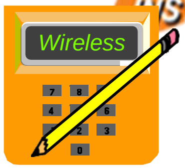
- At short range, R_c may not be close to -1. Therefor, nulls are less prominent than predicted by the simplified two-ray formula.
- UHF propagation for low antenna's (h_t = 5 .. 10 m)

$$p = r^{-\beta_1} \left(1 + \frac{r}{r_g} \right)^{-\beta_2}$$

Deterministic Models:

- Ray-tracing (ground and building reflection, diffraction, scattering)

Indoor Models



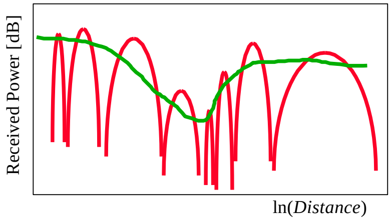
calculate

- Difficult to predict exactly
- Ray-tracing model prevail
- Some statistical Models, e.g.

COST 231: 800 MHz and 1.9 GHz

Environment	Exponent *n*	Propagation Mechanism
Corridors	1.4 - 1.9	Wave guidance
Large open rooms	2	Free space loss
Furnished rooms	3	FSL + multipath
Densely furnished rooms	4	Non-LOS, diffraction, scattering
Between different floors	5	Losses during floor / wall traverses

Statistical Fluctuations

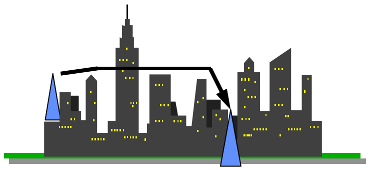


- Area-mean power
  - is determined by path loss
  - is an average over 100 m - 5 km
- Local-mean power
  - is caused by local 'shadowing' effects
  - has slow variations
  - is an average over 40 λ (few meters)
- Instantaneous power
  - fluctuations are caused by multipath reception
  - depends on location and frequency
  - depends on time if antenna is in motion
  - has fast variations (fades occur about every half a wave length)

Relevant to operator

Relevant to manufacturer

Shadowing



- Local obstacles cause random shadow attenuation
- Model: Normal distribution of the received power
- P_{Log} in logarithmic units (such as dB or neper),
- Probability Density:

$$f_{\bar{p}}(\bar{p}) = \frac{1}{\sqrt{2\pi}\,\sigma\,\bar{p}} \exp\left\{ -\frac{1}{2\sigma^2} \ln^2\left(\frac{\bar{p}}{\bar{\bar{p}}} \right) \right\},$$

where

σ is 'log. standard deviation' in neper ($\sigma_{dB} = 4.34\ \sigma$).

P_{Log} = ln [local-mean power / area-mean power

Assessment

- Link budget consists of calculation of
  a) Useful signal power
  b) Interfering noise power
  c) Useful signal & Interfering noise power
  d) Signal and Noise
- Link budget can help in predicting
  a) Equipment weight and size
  b) Technical risk
  c) Prime power requirements
  d) **Equipment weight and size, Technical risk and Prime power requirements**.
- Space loss occurs due to decrease in
  a) **Electric field strength**
  b) Efficiency
  c) Phase
  d) Signal power

Thank you