

SEMINAR

TEAM 1: SYSTEM PARAMETERS

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SYSTEM PARAMETERS

Received signal power: $P_r = (P_t, G_r, G_t, L_p)$
Received Sensivity: $S_r = (E_s/N_0, kT_0, R_s, F, L_r)$
Signal to Noise: $SNR = (P_t, G_r, G_t, kT_0, BW, F, L_p, L_r)$
Energy per bit to noise: $E_s/N_0 = (SNR, BW, N_0, R_s)$
...

P_r : received power
 P_t : Transmitted power;
 G_r, G_t : Antenna Gains
 L_p : Path loss
 kT_0 : $(1.38 \cdot 10^{-23} \text{ ws/k}) \cdot (290K)$
 R_s : Symbol rate
 F : Noise figure
 BW : Bandwidth
 L_r : Implementation loss (2-3 dB)

- *Received Signal Power:* $P_r = (P_t \cdot G_r \cdot G_t) / (L_p \cdot L_r)$
- *Signal-to-Noise Ratio:* $SNR = (P_t \cdot G_r \cdot G_t) / (kT_0 \cdot BW \cdot F \cdot L_p \cdot L_r)$
- *Ratio of signal energy to noise power spectral density:* $E_s/N_0 = SNR \cdot (BW/R_s) = (P_t \cdot G_r \cdot G_t) / (kT_0 \cdot R_s \cdot F \cdot L_p \cdot L_r)$
- *Receiver Sensitivity:* $SR = (E_s/N_0) \cdot kT_0 \cdot R_s \cdot F \cdot L_r$
- *Radiation pattern:* See “AntennaPattern.pdf”

TEAM 2: FADING

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FADING

Slow fading effects: $L_b(d) = (L(d), \sigma(x,y))$
Fast fading effects: $L_b(d) = (L(d), \sigma(x,y), R(x,y))$
 $L(d) = L_0 + 10n \log d$
...

$L(d)$: Loss distance d
 $\sigma(x,y)$: Gaussian random variable
 $R(x,y)$: Rayleigh random variable

- See: <http://www.mathworks.se/help/comm/ug/fading-channels.html>

TEAM 3: PATH LOSS & CELL SIZE

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PATH LOSS & CELL SIZE

Path loss (Free s): $L_p = (4\pi d / \lambda)^2 = (4\pi f d / c)^2$
Okumura-hata model: $L_p = (f, h_m, h_b, d)$

(Cell) Efficiency = (N_c, BW, A_c)

...

d: distance
 λ : wavelength
f: Frequency
c: light speed
 N_c : Number of channels per cell
BW: Bandwidth
 A_c : Area of cell.
 h_b : Height of base station Antenna
 h_m : Height of mobile station Antenna
f: Frequency of Transmission

- *Free Space*: $L_p = (4\pi d / \lambda)^2 = (4\pi f d / c)^2$
- *Hata Model for Urban Areas*: $L_{pu} = 69.55 + 26.16 \log f - 13.82 \log h_b - Ch + (44.9 - 6.55 \log h_b) \log d$
- *Hata Model for Suburban Areas*: $L_{psu} = L_{pu} - 2 (\log (f/28))^2 - 5.4$
- *Hata Model for Open Areas*: $L_{po} = L_{pu} - 4.78 (\log f)^2 + 18.33 \log f - 40.94$
- See: <http://www.mathworks.com/matlabcentral/fileexchange/2096-rf-wave-toolbox/content/RFWave/hata.m>
- Cell range versus cell edge throughput, See: cells.pdf

TEAM 4: PATH CHANGES & MOBILITY

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PATH CHANGES & MOBILITY

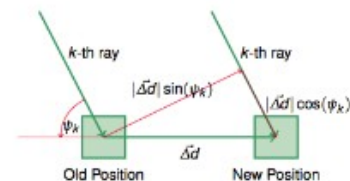
If a mobile constant velocity:

$|\Delta d| = vt$

$\Delta \phi_k(t) = -2\pi v / \lambda c \cdot \cos(\psi_k) t = -2\pi v / c \cdot f_c \cdot \cos(\psi_k) t$

...

$|\Delta d|$: distance between old and new position
v: velocity of the mobile
 $\Delta \phi_k(t)$: phase



- *Path-Changes Induced by Mobility*, See: Mobility.pdf (page 41-47)