MOBILNE KOMUNIKACIJE

1. DZ

Br. 0

1. $\sigma = 6.17 dB$ prigradsko

  $d = 50 km$ $EIRP = 500 W$

  $h_t = 100 m$ $f = 900 MHz$

  $h_r = 10 m$ $G_r = 1$

          $P_{rmin} = -101 dBm$

Okumura:

$$L_{50} = L_F + A(f,d) - a(h_t) - a(h_r) - G_{AREA}$$

$$\bullet \; L_F = 10 \log \left(\frac{4\pi d}{\lambda} \right)^2 = 125.506 \, dB$$

$$\bullet \; A(f,d) = 45 dB$$

$$\bullet \; a(h_t) = 20 \log \left(\frac{h_t}{200} \right) = -6 dB$$

$$\bullet \; a(h_r) = 10 \log \left(\frac{h_r}{3} \right) = 5.229 \, dB$$

$$\bullet \; G_{AREA} = 9.9 dB$$

$$L_{50} = 161.577$$

$$P_{r,m} = P_t (dBm) + G_t (dB) + G_r (dB) - L_{50}$$
$$P_{r,m} = EIRP (dBm) + G_r (dB) - L_{50} = -104.587 dBm$$

$$P_x(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left[-\frac{(x-\overline{x_m})^2}{2\sigma^2}\right]$$

$$x \in [-101, \infty)$$

$$x_m = -104.5873\,dBm$$

$$\sigma = 4.14$$

$$P = \int_{x_{min}}^{\infty} P_x(x)\,dx \qquad \Rightarrow \qquad MATLAB$$

$$0.91947$$

procenti

Može i

Ručno: $\quad u = \frac{x - x_m}{\sigma} = 0.9665$

$$\phi^* = 0.61406$$

$$P(x > x_{min}) = 0.19947$$

(1.) $\bar{x} = -60 dBm$ $\Rightarrow$ $\bar{x} = 1 \mu W$

$p(X < -97 dBm) = p(X < 19.95 nW)$

$p(X < -73 dBm) = p(X < 50.12 nW)$

$$p(x) = \frac{x}{\sigma^2} \exp\left(-\frac{x^2}{2\sigma^2}\right)$$

$$\bar{x} = \sigma\sqrt{\frac{\pi}{2}} \qquad \Rightarrow \qquad \sigma^2 = 6.366 \cdot 10^{-13}$$

$$cdf(x) = \int_0^{x_{max}} pdf(x)\, dx = 1 - \exp\left(-\frac{x^2}{2\sigma^2}\right) \approx \frac{x^2}{2\sigma^2}$$

$$p(X < -97 dBm) = 3.126 \cdot 10^{-4}$$

$$p(X < -73 dBm) = 1.971 \cdot 10^{-3}$$

② $h_t = 25$ urbano — veliki grad

$h_r = 1.5$

$f = 1.8 GHz$

$L_{50} = 140 dB \rightarrow r = ?$

$r_2 = 2r \rightarrow L_{50} = ?$

$L_{50} = A + B \log r \, (km) - \varepsilon$

$A = 69.55 + 26.16 \log f \, (MHz) - 13.82 \log h_t$

$$A = 135.39$$

$B = 44.9 - 6.55 \log h_t = 35.743$

$\varepsilon = 3.2 \left(\log (11.75 h_r) \right)^2 - 4.97 = -9.19 \cdot 10^{-4} \, dB$

ZANEMARIVO!

$\cdot \, L_{50} = 140 \quad \Rightarrow \quad r = 10^{\frac{L_{50}-A}{B}} = 1.345 \, km$

$\cdot \, r_2 = 2r = 2.69 \, km \qquad \Rightarrow L_{50} = 150.95 \, dB$

$\Delta L_{50} = 150.95 - 140 = 10.95 \, dB$

Po Friisovoj formuli:

$\Delta L = 20 \log \frac{4 \pi r_1}{\lambda} - 20 \log \frac{4 \pi r_2}{\lambda}$

$= 20 \log \left(\frac{1}{2} \right) = -6 \, dB$

① $h_z = 60m$ $d = 56m$

$f = 900 MHz$ $h_r = 5m$

$P_z = 10W$ $G_r = 3dBi$

$G_z = 10dBi$ $h_p = 400m$

· Okumura – Hata:

$$L(dB) = A + B \log d(km) - E - D$$

$A = 122.26$ ⎤

$B = 33.25$ ⎥ $L = 108.05 dB$

$D = 28.51$ ⎥

$E = 8.94$ ⎦

F – K parametar:

$d_1 = 3 km$ $h_{LOS} - 60 = \dfrac{5-60}{5000-0} \cdot 3000$

$d_2 = 2 km$

                        $h_{LOS} = 27m$

$$r = h\sqrt{\dfrac{2(d_1+d_2)}{\lambda d_1 d_2}}$$

                      $h = h_p - h_{LOS} = 373m$

$$r = 26.375$$

$$G_d(dB) = 20 \log\left(\dfrac{0.225}{r}\right) = -41.38 dB$$

$$P_r = P_z + G_z + G_r - L_{O-H} + G_d = -126.43 dBW$$

Ovaj baš i ne priča :-)

② $d = 30 km$

prigradsko (okumura)

$\frac{1}{d} = 900 MHz$

$h_z = 30$ $\qquad h_r = 1.5 m$

$L_{50} = L_F + A(f,d) - a(h_z) - a(h_r) - G_{AREA}$

$\cdot L_F = 20 \log \frac{4\pi d}{\lambda} = 121.09 dB$

$\cdot a(h_z) = 20 \log\left(\frac{h_z}{200}\right) = -16.48 dB$

$\cdot a(h_r) = 10 \log\left(\frac{h_r}{3}\right) = -3 dB$

$\cdot A(f,d) = 35 dB$

$\cdot G_{AREA} = 9.9 dB$

$\underline{L_{50} = 165.85 dB}$