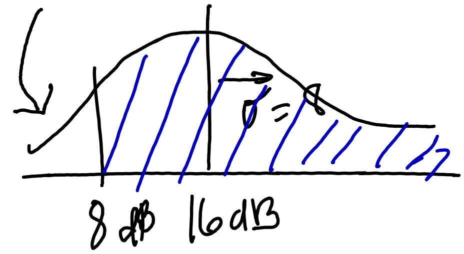
≈16% = Q(-8)



Log-Normal Fading, Link Budgets

Exercise 1: A cellular system is designed so that users on the cell edge have an average SNR of 16 dB. The system requires that users have a minimum SNR of 8dB to place a call. The standard deviation of the log-normal fading is 8dB. What fraction of users at the cell edge will be able to place calls?

$$\Pr[z > \gamma] = Q(\frac{\gamma - m}{\sigma}) = \frac{1}{2}\text{erfc}\left(\frac{\gamma - m}{\sqrt{2}\sigma}\right)$$

$\gamma = 8$

$m = 16$

$\sigma = 8$

$$= \frac{1}{2}\text{erfc}\left(\frac{8-16}{\sqrt{2}\cdot 8}\right)$$

=

```
octave:1> 0.5*erfc((8-16)/(sqrt(2)*8))
ans =  0.84134
octave:2>
```

84% will have SNR > 8dB.

Exercise 2: Which of the quantities above will be in dBm and which will be in dB?

(a) transmitter output power dBm
(b) transmit antenna gain dB
(c) path loss dB
(d) receive antenna gain dB
(e) receiver noise power dBm
(f) link margin dB

Exercise 3: Classify the likely origin for each of the values. For example, a physical constant, a system specification, a value chosen by the system designer or a value computed from other lines. Write the equation for each of the computed values in terms of the values of other lines.

a	transmitter power output	43	dBm (20 W)	– chosen
b	transmit antenna gain	20	dB	– "
c	frequency	4	GHZ	– "
e	wavelength	7.5	cm	– c/(c)
f	path distance	42,164	km	– constant
g	free-space path loss	197	dB	– from (e) and (f) [Friis]
h	receiver antenna gain	45	dB	– chosen
i	feedline loss	1	dB	– "
j	received signal power	-90	dBm	– = a+b-g+h-i
k	kT	-174	(dBm/Hz)	– constant
l	receiver noise bandwidth	67	dB-Hz (5 MHz)	– chosen
m	receiver noise figure	1	dB	– "
n	received noise power	-106	dBm	– = k+l+m
m	IF SNR	16	dB	– = j-n