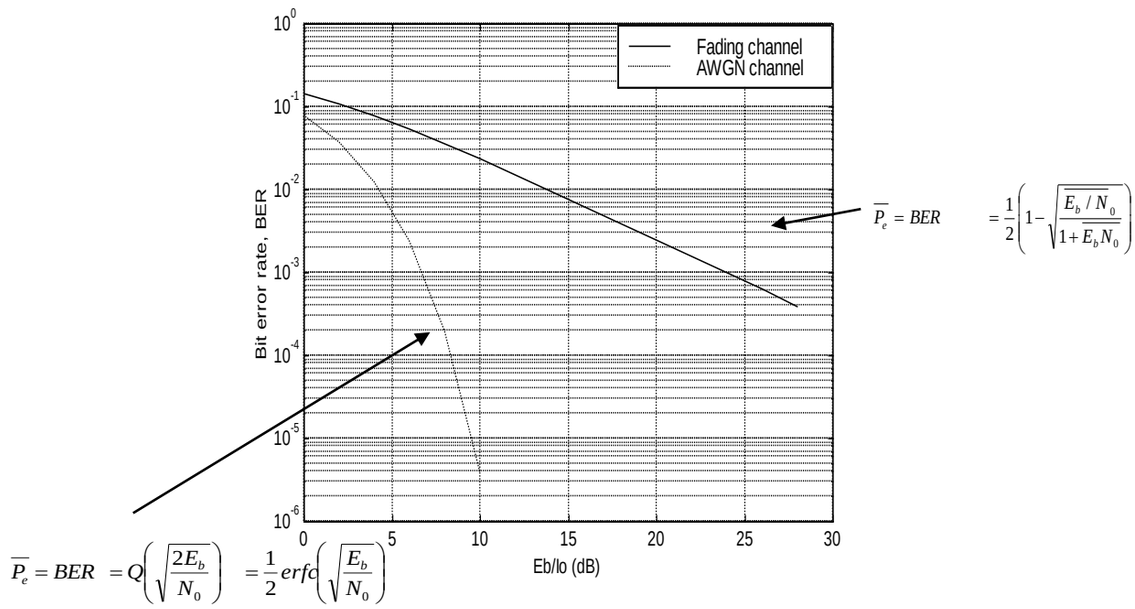
ASSIGNMET : WIRELESS ACCESS NETWORK (ET4061)
Due date : The day of Final Exam Sem I 2017/2018
REPORT : GROUP OF 4 STUDENTS (Collected by the day of final exam)

Performance of digital signal transmission through wireless channel is presented in terms of bit error rate (BER) as a function of signal-to-noise ratio per bit (SNR) or ratio of bit energy to noise power spectral (E_b/N_0) as shown in the Figure below: each for the AWGN channel as well as for the Rayleigh fading channel.

BER Performance in AWGN and Rayleigh fading Channel



Tasks :

1. To verify the BER = f(Eb/No) formula, students need to construct a computer simulation to prove the BER in AWGN channel for E_b/N_0 = 0, 2, 4, 6, dan 8 dB. The bit error is computed using Monte Carlo with 5 runs of simulation for each setting of E_b/N_0 given above. Plot the BER curve versus E_b/N_0 obtained from Monte Carlo simulation and compare with the theoretical BER versus E_b/N_o curve.

2. Construct computer simulation to plot the BER as a function of E_b/N_o for transmission through Rayleigh fading channel for E_b/N_0 = 0, 5, 10, 15, 20, dan 25 dB. Compare the results with that of theoretical performance. Fading channel **simulator** is provided in Matlab function (attached) as can be described as → y = fading(a, b, c), with a = the number of bit, b = maximum Doppler shift (fading rate), and c = bit period. Choose the Doppler shift f_D = 30 Hz, and the data rate = 128 Kbps with BPSK modulation.

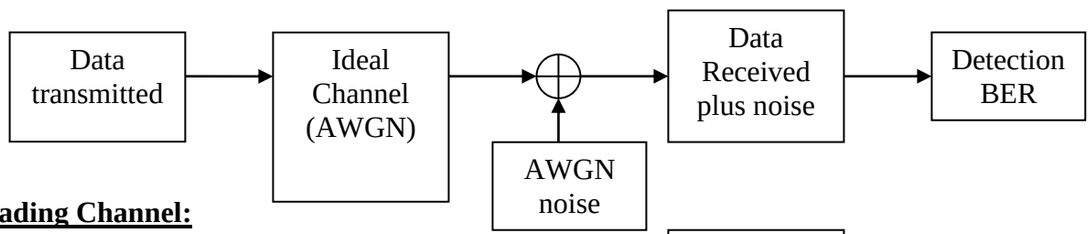
3. Construct computer simulation to show Rayleigh fading mitigation technique using Selection Diversity Combining (SDC) methods with 2 independent antennas, then verify using theoretical formula. Use Doppler frequency of 30 Hz and the sampling rate of SDC is 1,5 kHz (50 times higher tahn the Doppler). Show the fading signal strength for each antenna, as well as the combined signals after SDC combiner, and also show the BER performance versus Eb/No of 0, 5, 10, 15, 20, and 25 dB.

Simulator of Fading channel in Matlab function as follows:

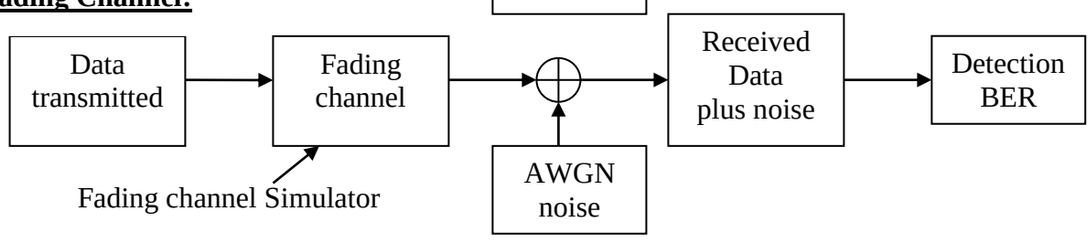
```
function y = fading(len, fd, T)
N = 34;
N0 = (N/2 - 1)/2;
alpha = pi/4;
xc = zeros(len,1);
xs = zeros(len,1);
sc = sqrt(2)*cos(alpha);
ss = sqrt(2)*sin(alpha);
ts = 0:len-1;
ts = ts'.*T + round(rand(1,1)*10000)*T;
wd = 2*pi*fd;
xc = sc.*cos(wd.*ts);
xs = ss.*cos(wd.*ts);
for lx =1:N0
   wn = wd*cos(2*pi*lx/N);
   xc = xc + (2*cos(pi*lx/N0)).*cos(wn.*ts);
   xs = xs + (2*sin(pi*lx/N0)).*cos(wn.*ts);
end;
y = (xc + i.*xs)./sqrt(N0+1);
```

Diagram of simulator as follows:

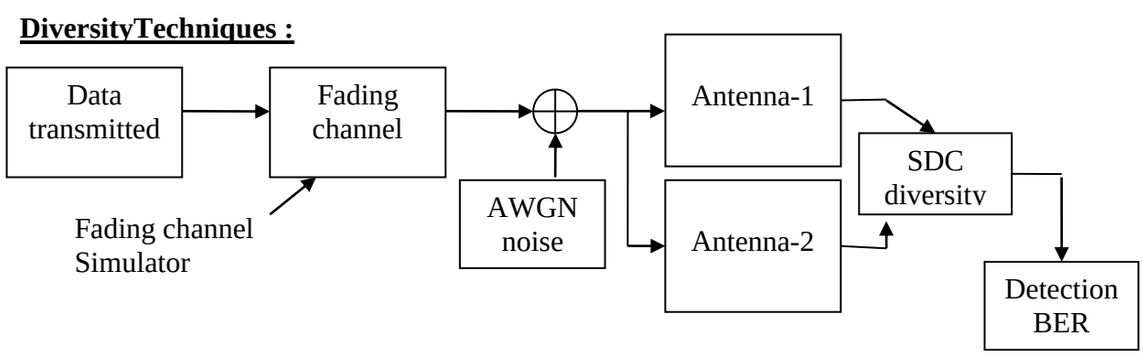
AWGN Channel



Fading Channel:



DiversityTechniques :



Notes:

1. To generate AWGN noise according to SNR in decibel (dB) can use conversion to linear scale using x dB = $10^{x/10}$.
2. For a known BER, determine the number of data required by the simulation program (the number of data error must be at least 10 for each run). For example, for BER = 10^{-3} will require the number of data at least 10 Kbit, for BER = 10^{-4} will require the number of data at least 100 Kbit.