PRINCIPLES OF COMMUNICATIONS

UNIT-3

LECTURE-4

Noise Analysis - AM, FM

The following assumptions are made:

- Channel model
  - distortionless
  - Additive White Gaussian Noise (AWGN)
- Receiver Model (see Figure 1)
  - ideal bandpass filter
  - ideal demodulator

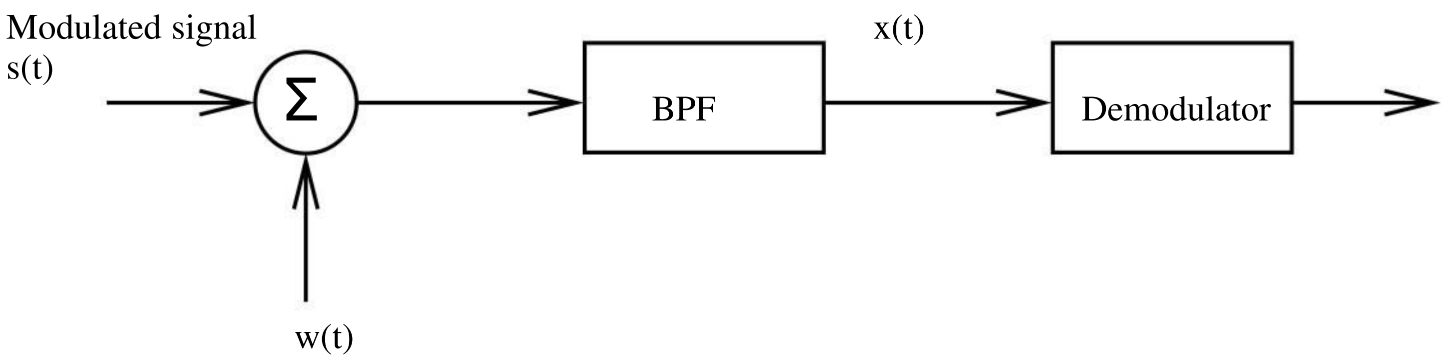

Figure 1: The Receiver Model

- BPF (Bandpass filter) - bandwidth is equal to the message bandwidth B
- midband frequency is ω_c.

Power Spectral Density of Noise

- $\frac{N_0}{2}$, and is defined for both positive and negative frequency (see Figure 2).
- N_0 is the average power/(unit BW) at the front-end of the

receiver in AM and DSB-SC.

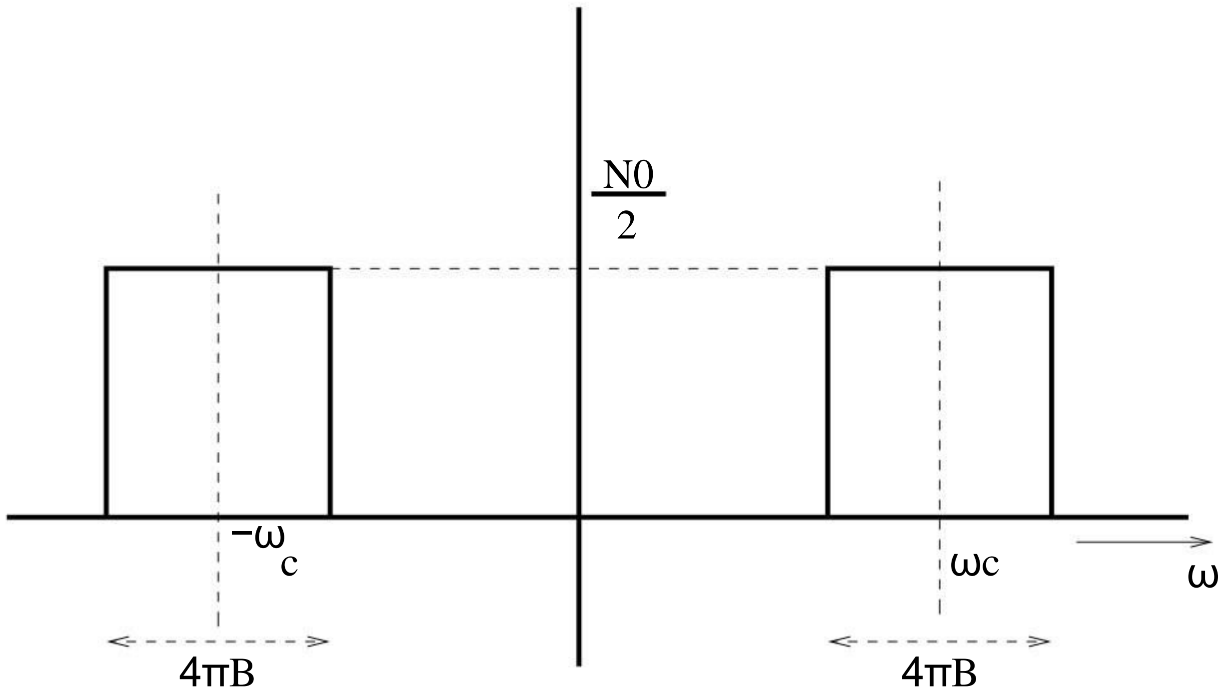

Figure 2: Bandlimited noise spectrum

The filtered signal available for demodulation is given by:

$$
\begin{aligned}
x(t) &= s(t) + n(t) \\
n(t) &= n_I(t)\cos\omega_c t \\
&\quad -n_Q(t)\sin\omega_c t
\end{aligned}
$$

$n_I(t)\cos\omega_c t$ is the in-phase component and

$n_Q(t)\sin\omega_c t$ is the quadrature component.

$n(t)$ is the representation for narrowband noise.

There are different measures that are used to define the Figure of Merit of different modulators:

- Input SNR:

$$
(SNR)_I = \frac{Average\ power\ of\ modulated\ signal\ s(t)}{Average\ power\ of\ noise}
$$

- Output SNR:

$$(SNR)_O = \frac{Average\ power\ of\ demodulated\ signal\ s(t)}{Average\ power\ of\ noise}$$

The Output SNR is measured at the receiver.

- Channel SNR:

$$(SNR)_C = \frac{Average\ power\ of\ modulated\ signal\ s(t)}{Average\ power\ of\ noise\ in\ message\ bandwidth}$$

- Figure of Merit (FoM) of Receiver:

$$FoM = \frac{(SNR)_O}{(SNR)_C}$$