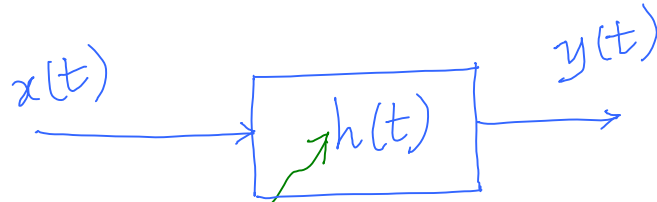


Wireless Channel

↓
Another important parameter

Coherence Bandwidth.

Time Domain:



Channel Response

We know,

CONVOLUTION.

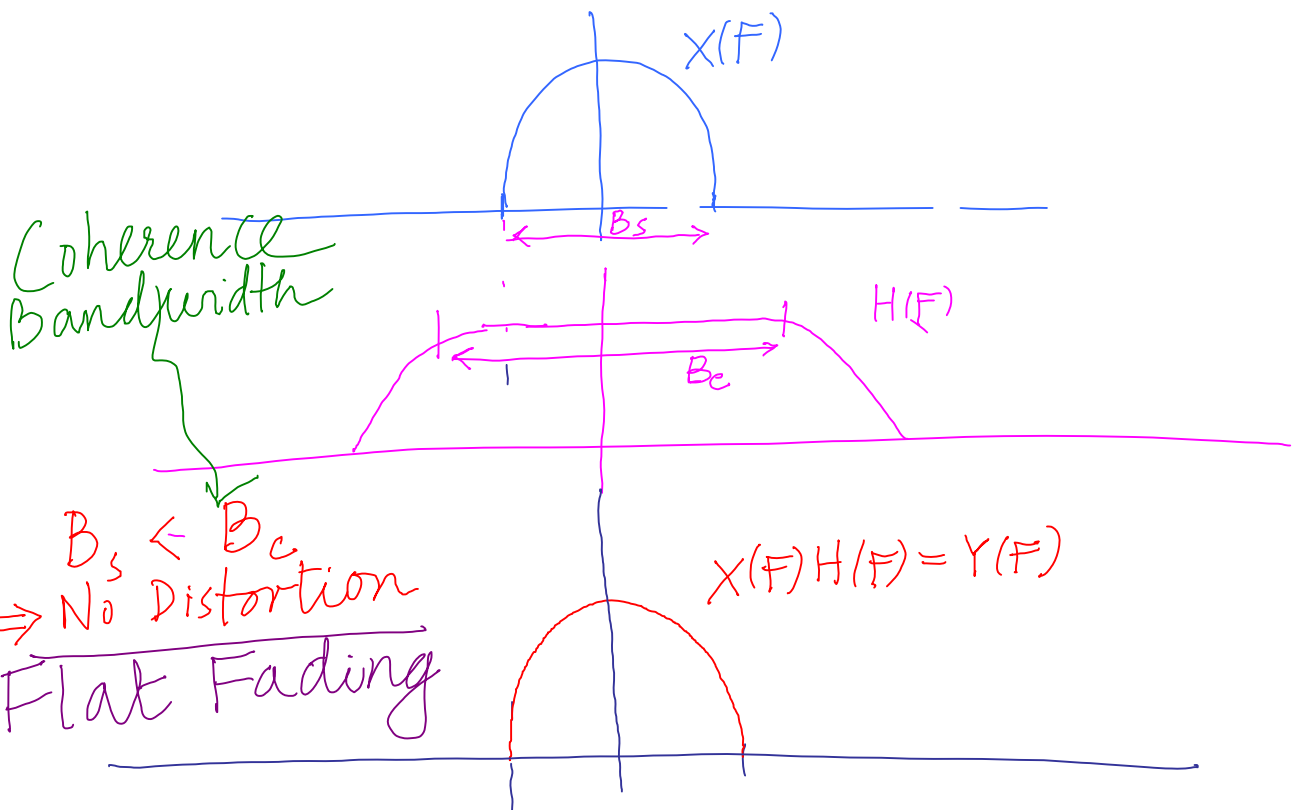
$$\underbrace{y(t)}_{\text{Rx Signal}} = \underbrace{x(t)}_{\text{Tx Signal}} \underbrace{* h(t)}_{\text{Response}}$$

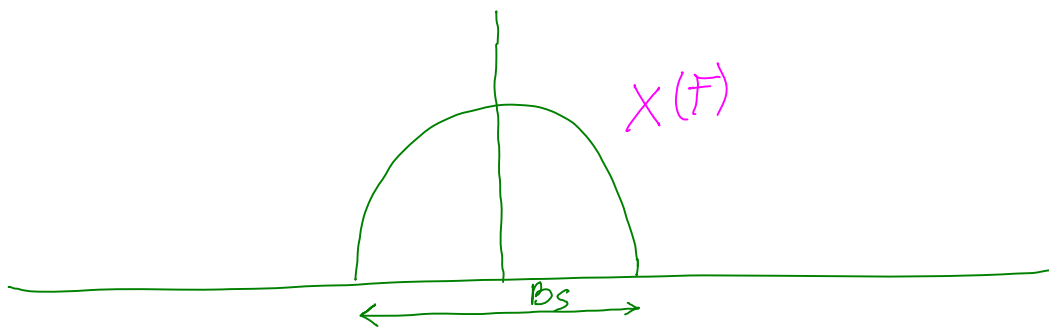
$$Y(F) = X(F) \cdot H(F)$$

Freq. Response
of Rx Signal

Channel
Freq. Response

Freq. Response
of input signal.

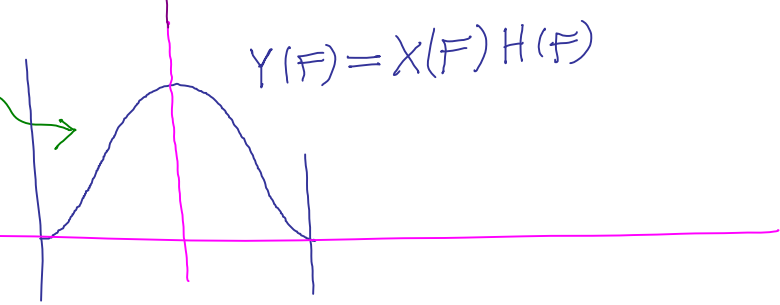




Frequency selective



~~DISTORTION~~
 $B_s > B_c$



B_c — Coherence BW
Flat portion of channel
BW
 $B_s < B_c \Rightarrow$ Flat Fading
No Distortion

$B_s > B_c \Rightarrow$ Freq Selective
Fading
Distortion.

$$h(t) = \sum_{i=0}^{L-1} a_i \delta(t - \tau_i)$$

$$\delta(t - \tau_i) \longleftrightarrow \int_{-\infty}^{\infty} \delta(t - \tau_i) e^{-j2\pi F t} dt$$

$$= e^{-j2\pi F \tau_i}$$

$$\delta(t - \tau_i) \longleftrightarrow e^{-j2\pi F \tau_i}$$

$$\sum_{i=0}^{L-1} a_i \delta(t - \tau_i) \longleftrightarrow \sum_{i=0}^{L-1} a_i e^{-j2\pi F \tau_i}$$

$$H(F) = \sum_{i=0}^{L-1} a_i e^{-j2\pi F \tau_i}$$

Fourier Transform of $h(t)$

Fourier Transform of the
multipath channel response.

$$e^{-j2\pi F\tau_i}$$

At $F = 0$ phase $= 2\pi F\tau_i = 0$

At $F = \frac{1}{2\tau_i}$ phase $= 2\pi \frac{1}{2\tau_i} \cdot \tau_i = \pi$

Phase has changed significantly
 Freq. Response has changed significantly

$$F = \frac{1}{2\tau_i} \Rightarrow BW = 2 \times \frac{1}{2\tau_i} = \frac{1}{\tau_i}$$

↑
 ith path

In general, approximately
the BW of channel

$$BW = \frac{1}{\sigma_\tau} = B_c$$

Coherence BW

$$\Rightarrow B_c = \frac{1}{\sigma_\tau}$$

Delay Spread.

$$\sigma_z = 2 \mu s$$

$$B_c = \frac{1}{\sigma_z} = \frac{1}{2 \mu s}$$

$$B_c = 500 \text{ kHz}$$

typical coherence BW.

Frequency selective Distortion

$$\text{if } B_s > B_c$$
$$\frac{1}{T} > \frac{1}{\sigma_z}$$

$$\Rightarrow \sigma_z > T$$

$$\text{ISI}$$

Summary:

IF $B_s > B_c \Rightarrow \sigma_c > T$
 $\Rightarrow$ Frequency Selective Fading
 $\Rightarrow$ ISI

IF $B_s < B_c \Rightarrow \sigma_c < T$
 $\Rightarrow$ Frequency Flat Fading
 $\Rightarrow$ No ISI.