

# Shannon Limit

In AWGN (Additive White Gaussian Noise),

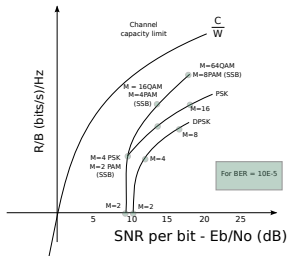
$$C = B \log_2 \left( 1 + \frac{S}{N} \right)$$

- ▶ SNR (dB) =  $10 \log_{10} \left( \frac{S}{N} \right)$
- ▶ Can calculate
  - ▶ limit to how much data can be sent through bandwidth  $B$ .
  - ▶ minimum SNR to be able to get given data rate in given bandwidth  $B$ .

# Capacity Trade Offs

Trade off of 3 variables

- ▶ BER (bit error rate)
- ▶ Power Efficiency ( $\frac{E_b}{N_0}$ )
- ▶ Spectral Efficiency ( $bps/Hz$ )



Based on Proakis "Digital Communication".

Modulation schemes (PSK, FSK, QAM) will be covered later.

# Interesting Points

- ▶ Without noise - capacity would be infinite. (Even with Interference)
- ▶ For a Probability of Error of 0.5, can send infinite data, even with noise!