## Electrical Communication Systems

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 $\fbox{Source} \rightarrow \fbox{Transmitter} \rightarrow \fbox{Channel} \rightarrow \fbox{Receiver} \rightarrow \fbox{Sink}$ 

#### 1.1 The Fundamental Transmission Limit

Theorem 1.1.1 Shannon's Theorem

The theoretical limit for error-free transmission in a communications system in the presence of noise (the channel capacity) is a function of the channel bandwidth B and the signal to noise power ration S/N.

$$C = B \log_2(1 + S/N) \tag{1.1}$$

Example 1.1.1 (Shannon's Theorem)

Given a 1[W] signal perturbed by 1[mW] of noise, the SNR is 1000. In dB, the SNR is

$$dB = 10 \log_{10}(SNR).$$
(1.2)

In this case, the SNR is 30[dB].