EE910: Digital Communication Systems-I

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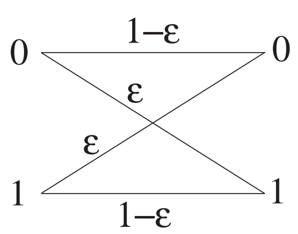
Lecture #1B: Communication channels and models

Communication Channels

- Channel is the transmission medium over which we transmit information bits.
- Examples
  - Wireline channel
  - Wireless channel
  - Underwater acoustic channel
  - Storage channel

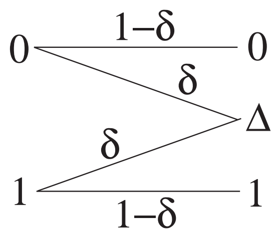
Binary Symmetric Channel



Model for Binary Symmetric Channel

- It is a binary input, binary output symmetric channel.
- ϵ denotes the crossover probability.

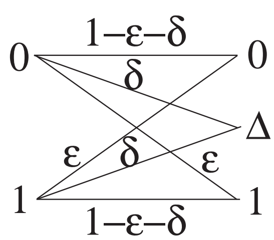
Binary Erasure Channel



Model for Binary Erasure Channel

- It is a binary input, ternary output symmetric channel.
- δ denotes the erasure probability.

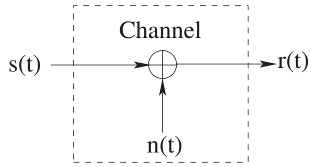
Binary Symmetric Erasure Channel



Model for Binary Symmetric Erasure Channel

- It is a binary input, ternary output symmetric channel.
- ϵ denotes the crossover probability.
- δ denotes the erasure probability.

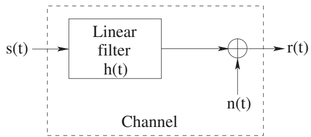
Additive Noise Channel



Model for Additive Noise Channel

- In this model, transmitted signal $s(t)$ is corrupted by an additive random noise process $n(t)$.
- Typically, noise is characterized statistically as a Gaussian noise process.
- Noise that has constant power spectral density is known as white noise.
- Additive white Gaussian noise (AWGN) channel is used to model a broad class of physical communication channels.

Linear Filter Channel



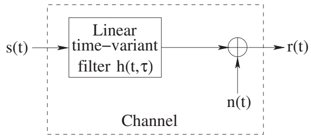
Model for Linear Filter Channel

- If channel input is $s(t)$, output $r(t)$ is given by

$$r(t) = \int_{-\infty}^{\infty} h(\tau)s(t-\tau)d\tau + n(t) \qquad (1)$$

where $h(t)$ is the impulse response of the linear filter, $n(t)$ is the additive random noise process.

Linear Time-Variant Filter Channel



Model for Linear Time-Variant Filter Channel

- In this case, the linear filter is characterized by time-variant channel impulse response $h(t, \tau)$.
- A typical time-variant channel impulse response $h(t, \tau)$ is of the form

$$h(t, \tau) = \sum_{i=1}^{L} a_k(t)\delta(\tau - \tau_k) \quad (2)$$

where the $\{a_k(t)\}$ represents the time-variant attenuation factors for the L multipath propagation paths and $\{\tau_k\}$ are the corresponding time delays.