ELC 5396: Digital Communications

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Communication Systems

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  Provide for electronic exchange of multimedia data
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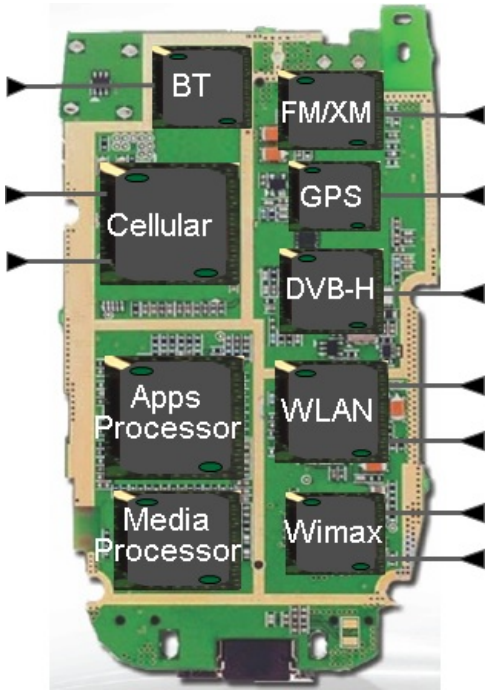
- **Communication Systems Today**
  Radio and TV broadcasting
  Public Switched Telephone Network (voice,fax,modem)
  Cellular Phones
  Computer networks (LANs, WANs, and the Internet)
  Satellite systems (pagers, voice/data, movie broadcasts)
  WiFi and Bluetooth

Device Challenges

- Analog and RF Components
- A/D Converters
- Size, Power, Cost
- Multiple Antennas
- Multiradio Coexistance



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- **Network Design**
  Connectivity and high speed
  Energy and delay constraints

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6. Easier data multiplexing
7. Facilitate data compression

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4. Non-graceful degradation

Goals in Communication System Design

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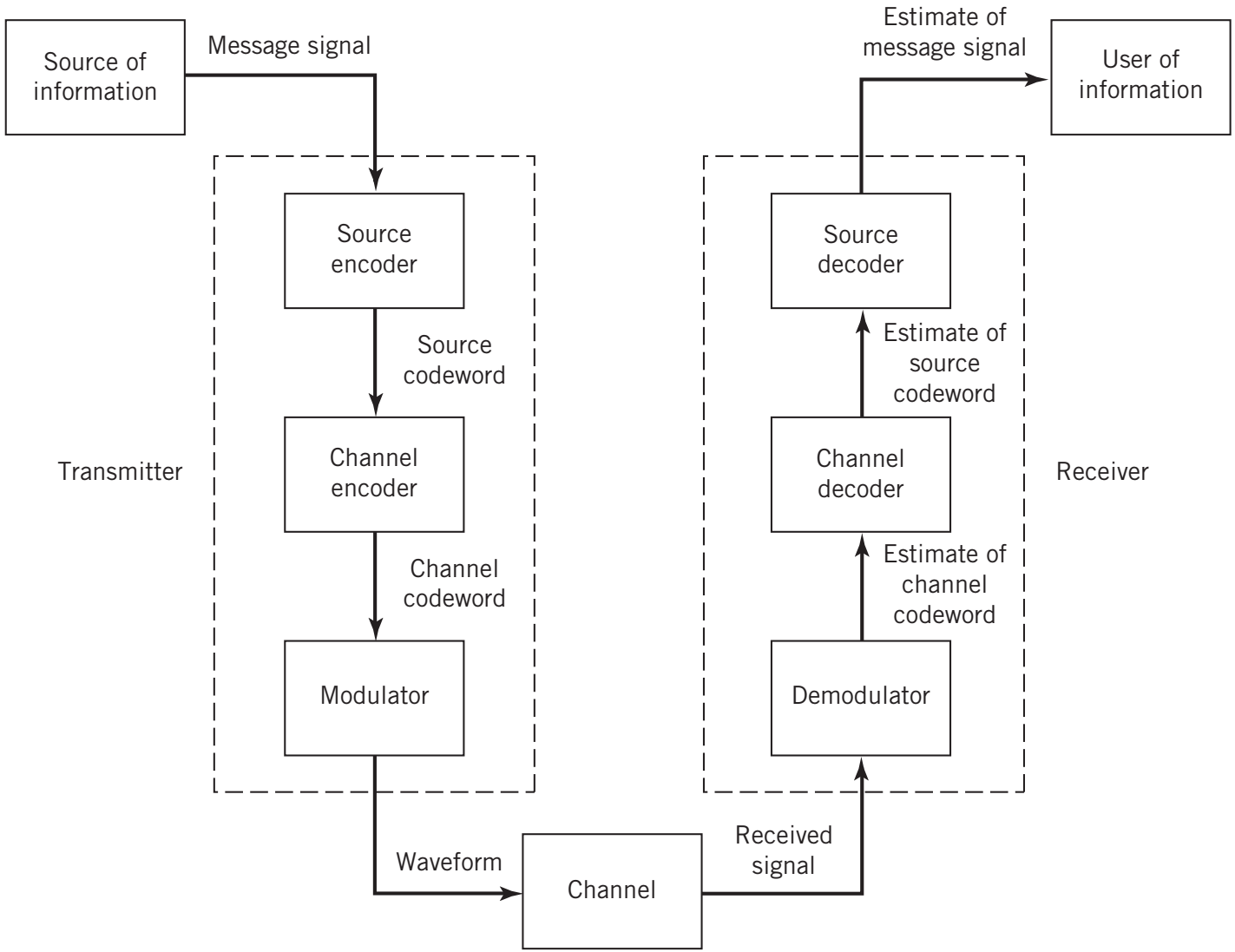
6. To minimize required power, E_b/N_0

Block Diagram of Digital Communication System



Information Source and Sink

- Information Source and Input Transducer:
  The source of information can be analog or digital,
  Analog: audio or video signal,
  Digital: like teletype signal.
  In digital communication the signal produced by this source is converted into digital signal consists of 1's and 0's.

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- Output Transducer:
  The signal in desired format analog or digital at the output

Channel

- Channel:
  The communication channel is the physical medium that is used for transmitting signals from transmitter to receiver
  Wireless channels: Wireless Systems
  Wired channels: Telephony

  Channel discrimination on the basis of their property and characteristics, like AWGN channel etc.

Source Encoder and Decoder

- Source Encoder
  In digital communication we convert the signal from source into digital signal.
  The point to remember is we should like to use as few binary digits as possible to represent the signal. In such a way this efficient representation of the source output results in little or no redundancy. This sequence of binary digits is called information sequence.

  Source Encoding or Data Compression: the process of efficiently converting the output of analog or digital source into a sequence of binary digits is known as source encoding.

Source Encoder and Decoder

- Source Decoder
  Source decoder tries to decode the sequence from the knowledge of the encoding algorithm, which results in the approximate replica of the input at the transmitter end.

Channel Encoder and Decoder

- Channel Encoder:
  The information sequence is passed through the channel encoder.
  The purpose of the channel encoder is to introduce, in controlled manner, some redundancy in the binary information sequence that can be used at the receiver to overcome the effects of noise and interference encountered in the transmission on the signal through the channel.

  e.g. take k bits of the information sequence and map that k bits to unique n bit sequence called code word. The amount of redundancy introduced is measured by the ratio n/k and the reciprocal of this ratio (k/n) is known as rate of code or code rate.

Channel Encoder and Decoder

- Channel Decoder:
  Channel decoder attempts to reconstruct the original information sequence from the knowledge of the code used by the channel encoder and the redundancy contained in the received data.

Digital Modulator and Demodulator

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  The binary sequence is passed to digital modulator which in turns convert the sequence into electric signals so that we can transmit them on channel.
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- Digital Demodulator:
  The digital demodulator processes the channel corrupted transmitted waveform and reduces the waveform to the sequence of numbers that represents estimates of the transmitted data symbols.

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- Channel can introduce many types of errors due to thermal noise, interference, etc.
- The demodulator and decoder should provide low Bit Error Rate (BER).