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EE 342

For KCST

EE101 - EE112 - EE211 - EE201 - EE212 - EE312 - EE341 - EE342 - EE351 - EE352 - EE365 - EE410 - EE441 - EE442 - EE443 - EE451

فالكم A

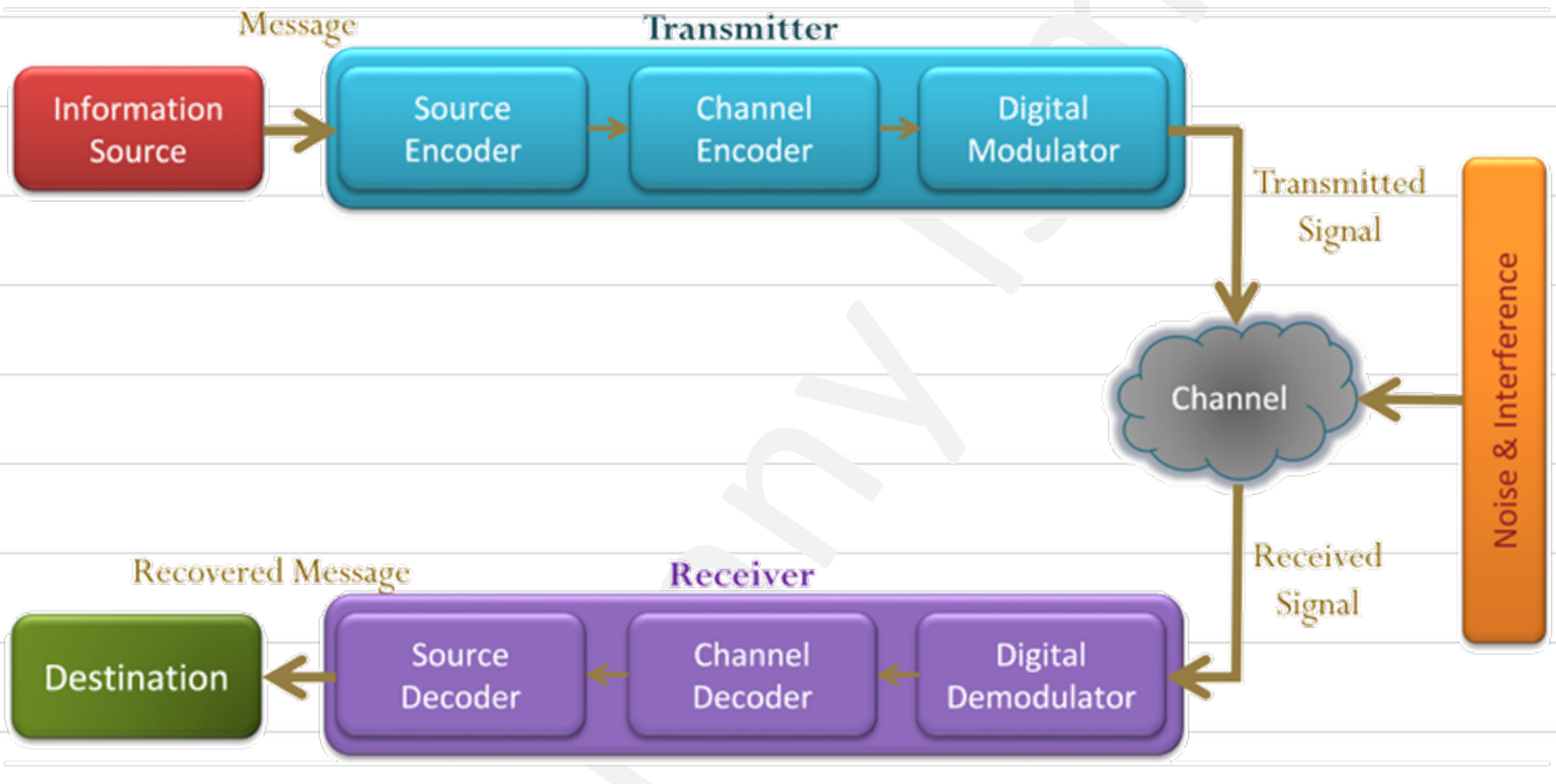
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<< Ch 2 - Part A >>

* message :

Analog (continous) - Digital (discrete)

<< Elements of Digital communication system:



<< Information Source:

The source output (message).

<< Source encoder:

Convert message to bits (0's, 1's).

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<< Channel encoder:

Add redundancy to overcome the effects of noise and interference.

<< Digital Modulator:

Map binary information into waveform.

<< Channel:

physical meduim which send the signal from transmiter to receiver.

<< Digital Demodulator:

Map waveform into binary.

<< Channel Decoder:

Remove redundancy.

<< Source Decoder:

Convert bits to message.

<< Destination:

Which receive the message.

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☆ Expected Vale / average :

$$E[\ell(x)] = \sum P(x) \cdot L(x)$$

P(x) → Probability

L(x) → length of message

Probability ⟶ نسبة مئوية

Length ⟶ عدد الـ bits في الـ message

* Source Encoder :

① Ascii (standard).

② Huffman.

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Example 2.10. Suppose the message is a sequence of basic English words which happen according to the probabilities provided in the table below.

x	$p(x)$	Codeword $c(x)$	$\ell(x)$
Yes	4%	00	2
No	3%	01	2
OK	90%	10	2
Thank You	3%	11	2

$2^n = 2 \Rightarrow 4$

$E[\ell(x)] = \sum P(x)\,\ell(x)$

$= \frac{4}{100} \times 2 + \frac{3}{100} \times 2 + \frac{90}{100} \times 2 + \frac{3}{100} \times 2$

$= 2$ bits / source symbol

Example 2.12. Back to Example 2.10. Consider a new encoder:

x	$p(x)$	Codeword $c(x)$	$\ell(x)$
Yes	4%	01	2
No	3%	001	3
OK	90%	1	1
Thank You	3%	0001	4

$E[\ell(x)] = \sum P(x)\,\ell(x)$

$= 0.04 \times 2 + 0.03 \times 3 + 0.9 \times 1 + 0.03 \times 4$

$= 1.19$ bits / source symbol

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Example 2.14. Thought experiment: Let's consider the following code

x	$p(x)$	Codeword $c(x)$	$\ell(x)$
1	4%	0	1
2	3%	1	1
3	90%	0	1
4	3%	1	1

$$E[\ell(x)] = \sum p(x)\,\ell(x)$$

$$= 0.04 \times 1 + 0.03 \times 1 + 0.9 \times 1 + 0.03 \times 1$$

$$= 1 \text{ bits / source symbol}$$

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Suppose the message is consists of the set {a,b,c,d} which happen according to the probabilities providing in the following tables. We have two different codeword for each set, which one is better?

(A)

x	p(x)	Codeword c(x)	ℓ(x)
a	70%	0	1
b	10%	1	1
c	15%	00	2
d	5%	111	3

(B)

x	p(x)	Codeword c(x)	ℓ(x)
a	70%	01	2
b	10%	00	2
c	15%	10	2
d	5%	11	2

(A)

$$E[\ell(x)] = \sum p(x) \cdot \ell(x)$$

$$= 0.7 \times 1 + 0.1 \times 1 + 0.15 \times 2 + 0.05 \times 3$$

$$= 1.25 \text{ bits / source symbol}$$

(B)

$$E[\ell(x)] = \sum p(x) \cdot \ell(x)$$

$$= 0.7 \times 2 + 0.1 \times 2 + 0.15 \times 2 + 0.05 \times 2$$

$$= 2 \text{ bits / source symbol}$$

∴ Code A is better than code B

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