Signal transmission

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Inhalt

Overview

Overview

Mission

- Transmission of information/messages over
  space (from place to place)
  time (storage)
- in the most efficient way

Fields of application

- Network (LAN, WLAN, mobile communication)
- IT systems (computer, smartphones, etc.)
- Storage media (CD, DVD, Blu-ray disk, HDDs)
  $\Longrightarrow$ Almost everywhere

Signal transmission

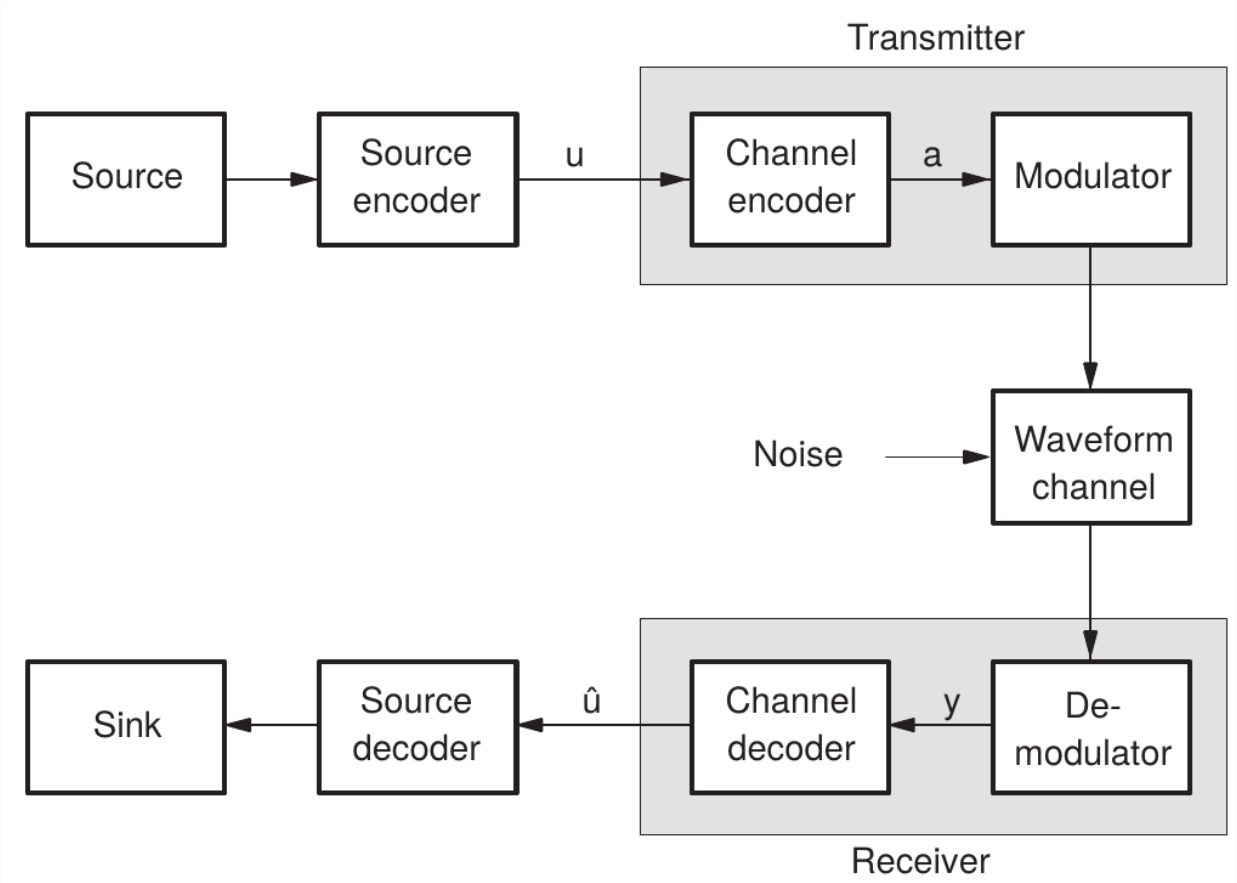


Figure 1: Overview signal transmission [2]

Signals

What is a signal?

- Representation of messages/information by a physical process
- e.g. voltage/current versus time, sound pressure over time

Types of signals

- Analog signals vs. digital signals
- Deterministic (known) vs. random (unknown)

Source/Transmitter

- Adaptation of the source signal to the transmission medium
- Reduction of redundancy + irrelevance for efficient use of the transmission channel (source coding)
- Redundancy insertion to secure the message against interference and falsification (channel coding)
- Efficient use of available transmission power and signal bandwidth

Channel

What is a channel?

- Wire, air, storage device
- Determined by the physical properties of the transmission medium

What does it do?

- Carriage of the transmitted signal to the receiver
- Channel attenuates the transmit signal, causes distortion
- Interruptions (noise, interference) overlap

Sink/Receiver

- Recovery of the source signal from the received signal
- Extraction of as much information as possible about the source signal contained in the received signal
- Adaptation of the received signal to sink

Coding

What is a coding?

A mapping rule that uniquely assigns a character or string to each character of a source word.

$$\underbrace{(a \quad b \quad c)}_{\text{source alphabet}} = \underbrace{(0 \quad 1)}_{\text{target alphabet}}$$

Mapping: $(a \mapsto 0, b \mapsto 01, c \mapsto 011)$

Example

Source word: acabc

$$\underbrace{(acabc)}_{\text{source word}} = \underbrace{(0 \quad 011 \quad 0 \quad 01 \quad 011)}_{\text{code word}}$$

Source coding

Recap: Signal transmission

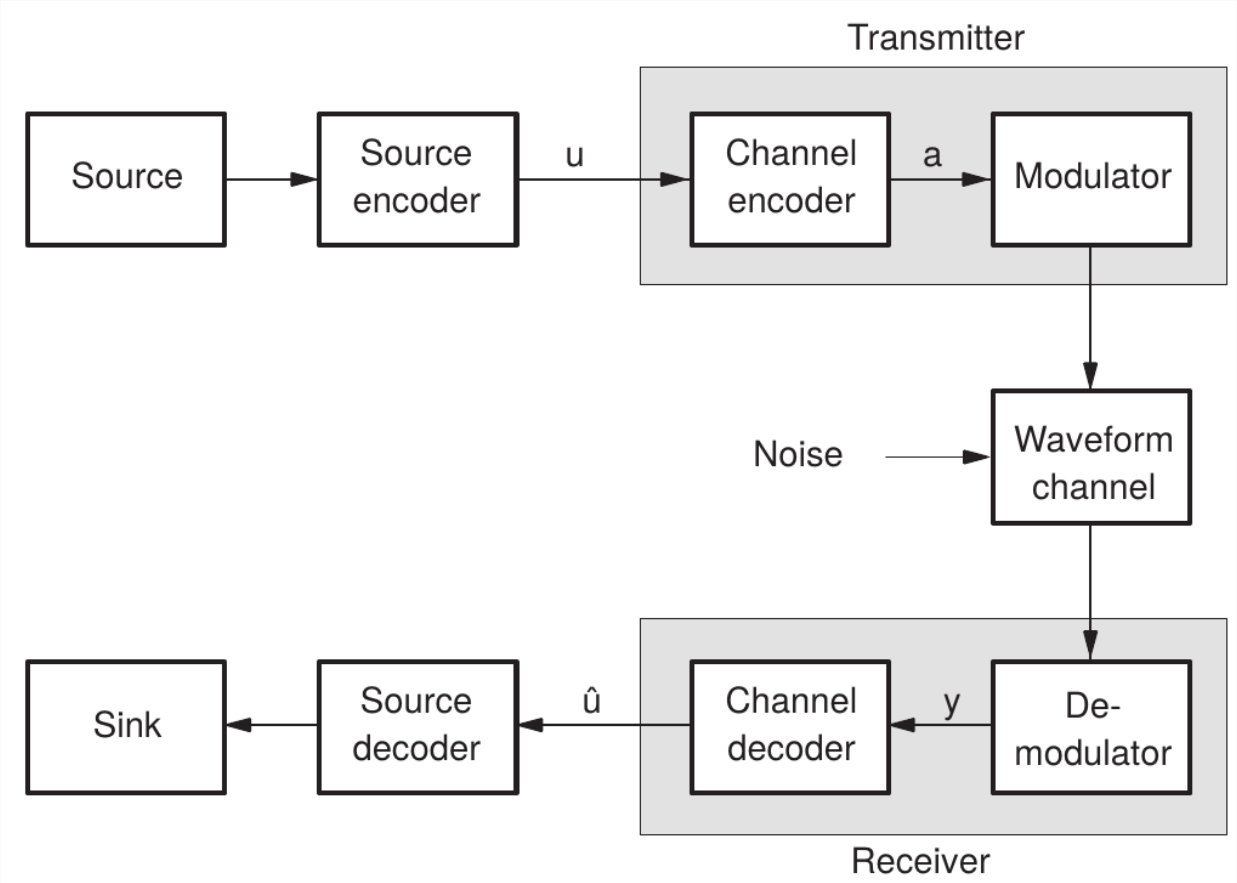


Figure 2: Overview signal transmission [2]

Source coding

What is it?

- Removal of redundant information
- Data compression

How is it achieved?

- Mapping of source words with high probability to short code words

Source coding: Example I - Huffman coding

Assumption:

$Pr\{A\} = 0,8$

$Pr\{B\} = 0,2$

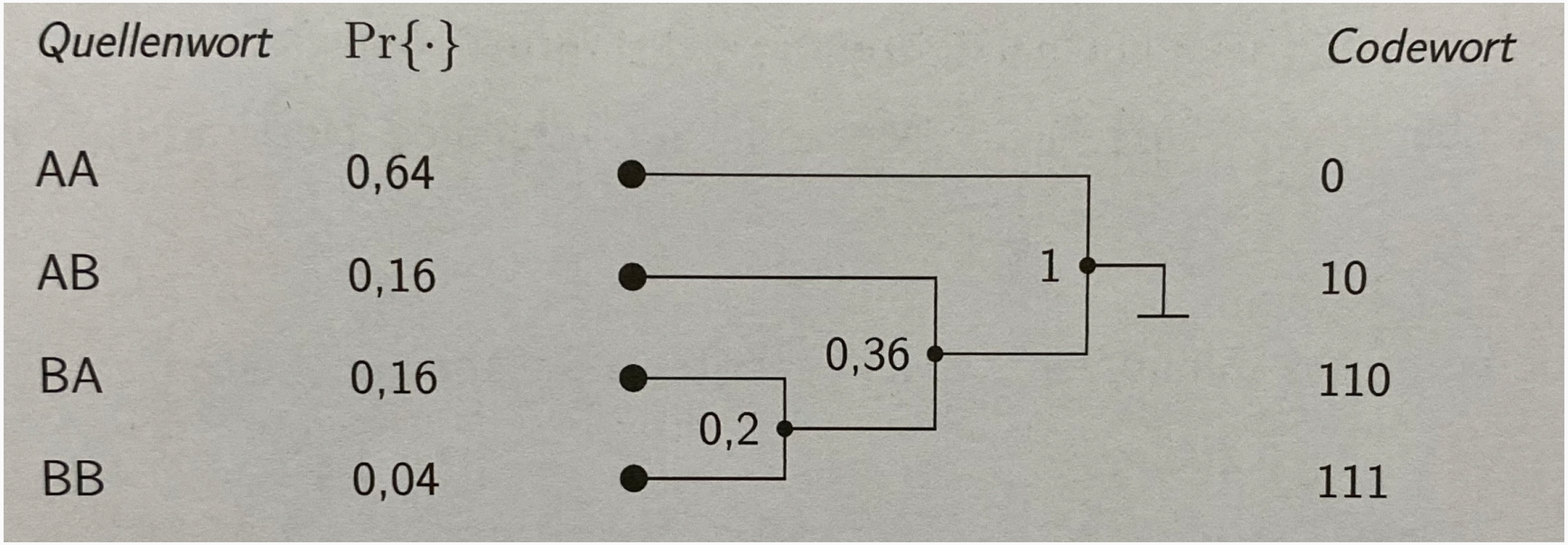


Figure 3: Example I Huffman coding [3]

Source coding: Example II - Huffman coding

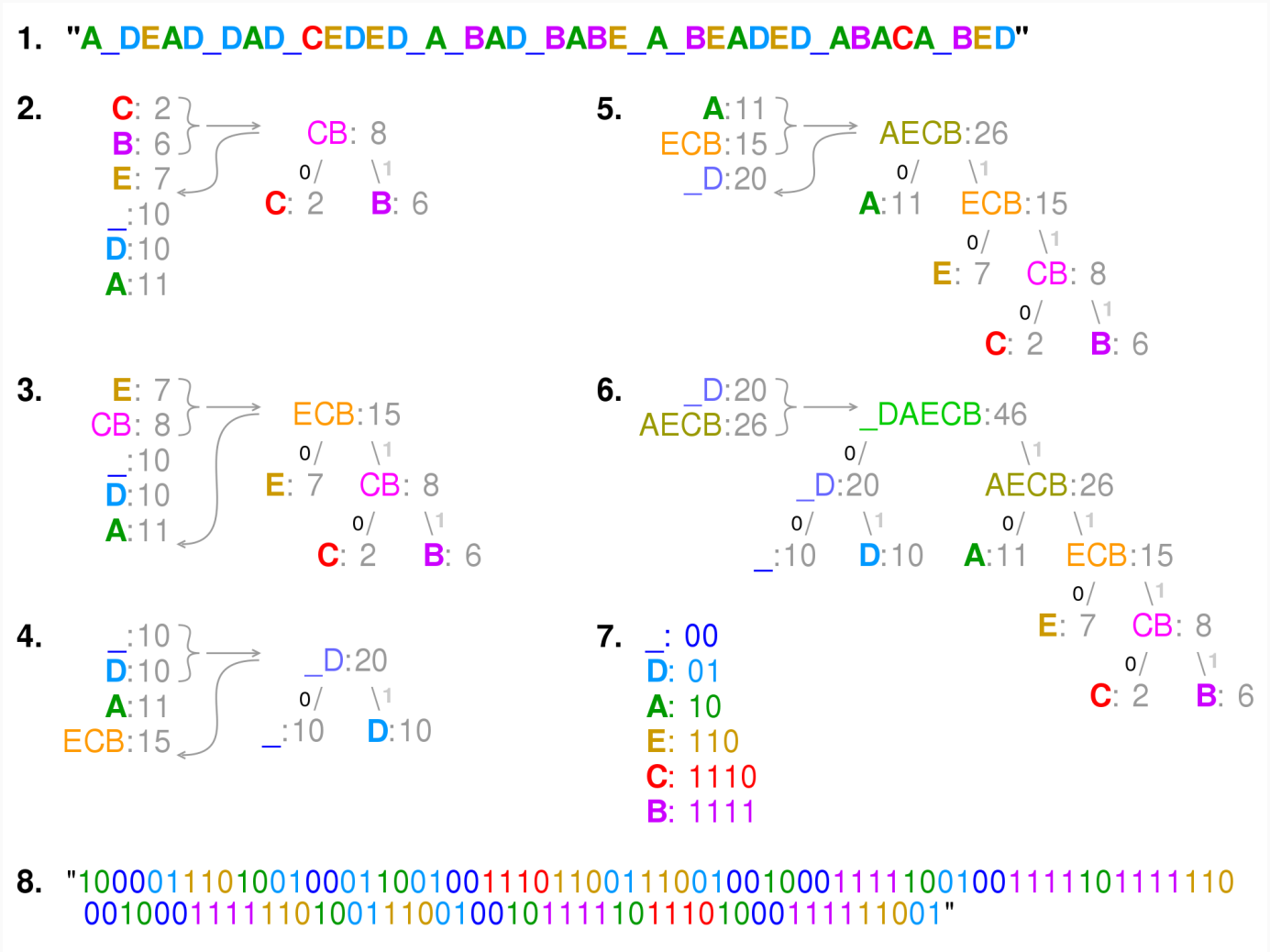


Figure 4: Example II Huffman coding [1]

Channel coding

Recap: Signal transmission

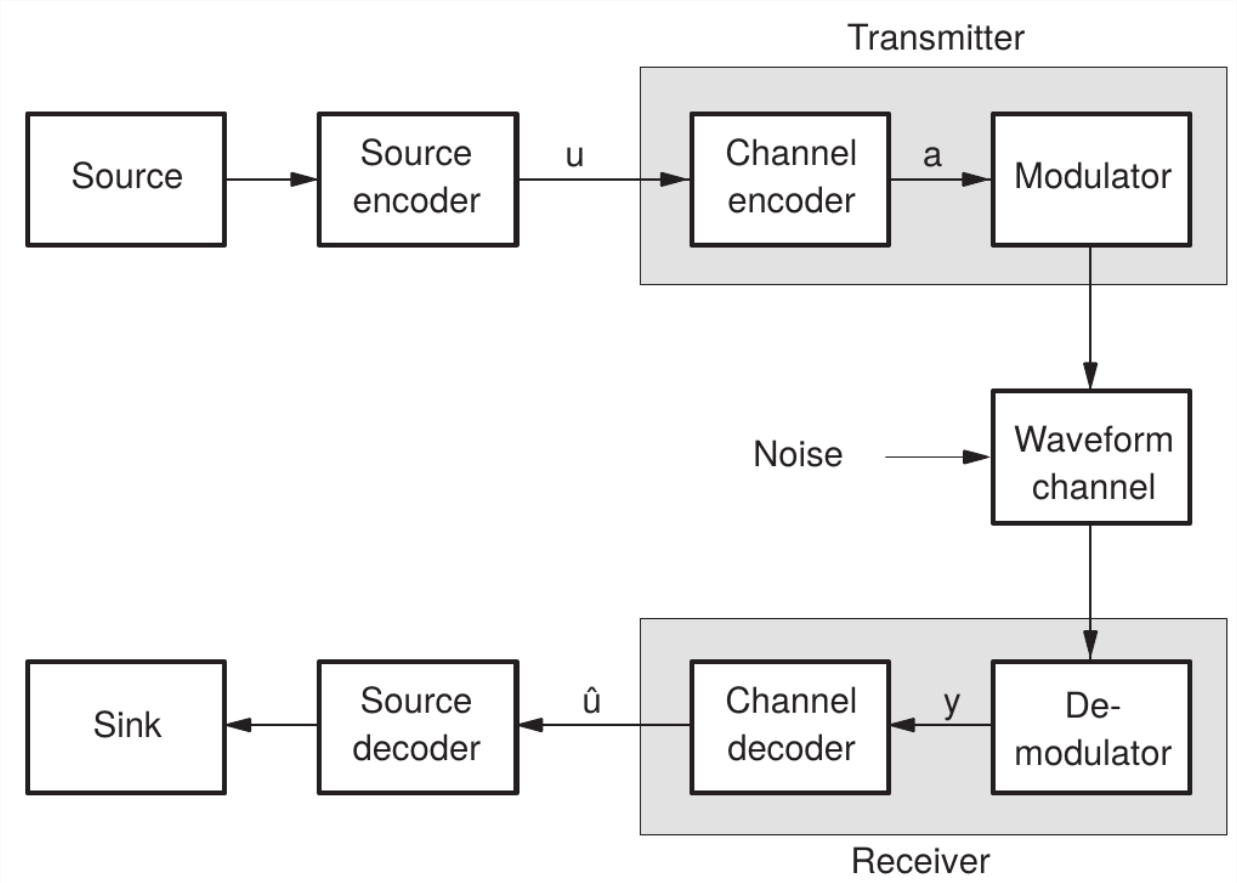


Figure 5: Overview signal transmission [2]

Channel coding: What is it?

- When transmitting and storing data, errors must be expected
- Securing the message against errors
  $\Longrightarrow$ Adding **redundancy** on the transmitting side
- Receiver uses this redundancy to detect + correct errors
- **Task**: error detection and if necessary error correction based on redundancy

Channel coding: Example

- International Standard Book Number (**ISBN**)

Figure 6: A 10-digit ISBN and the corresponding EAN-13 [4]

Summary

Summary

- Signal transmission is almost everywhere

  $\Rightarrow$ Processing of the signal is necessary

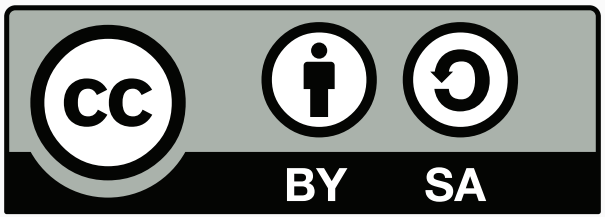
- Data compression (source coding)

- Securing the message against errors (channel coding)
  $\Rightarrow$ redundancy

Source

Get the source of this presentation from

`github.com/nodeg/talks`



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