

Reasons for using binary interface

- ① Shannon has proven that it is a good way to do so
- ② Hardware is a) very cheap and b) small
- ③ Standardization
- ④ Simplifies implementation and understanding

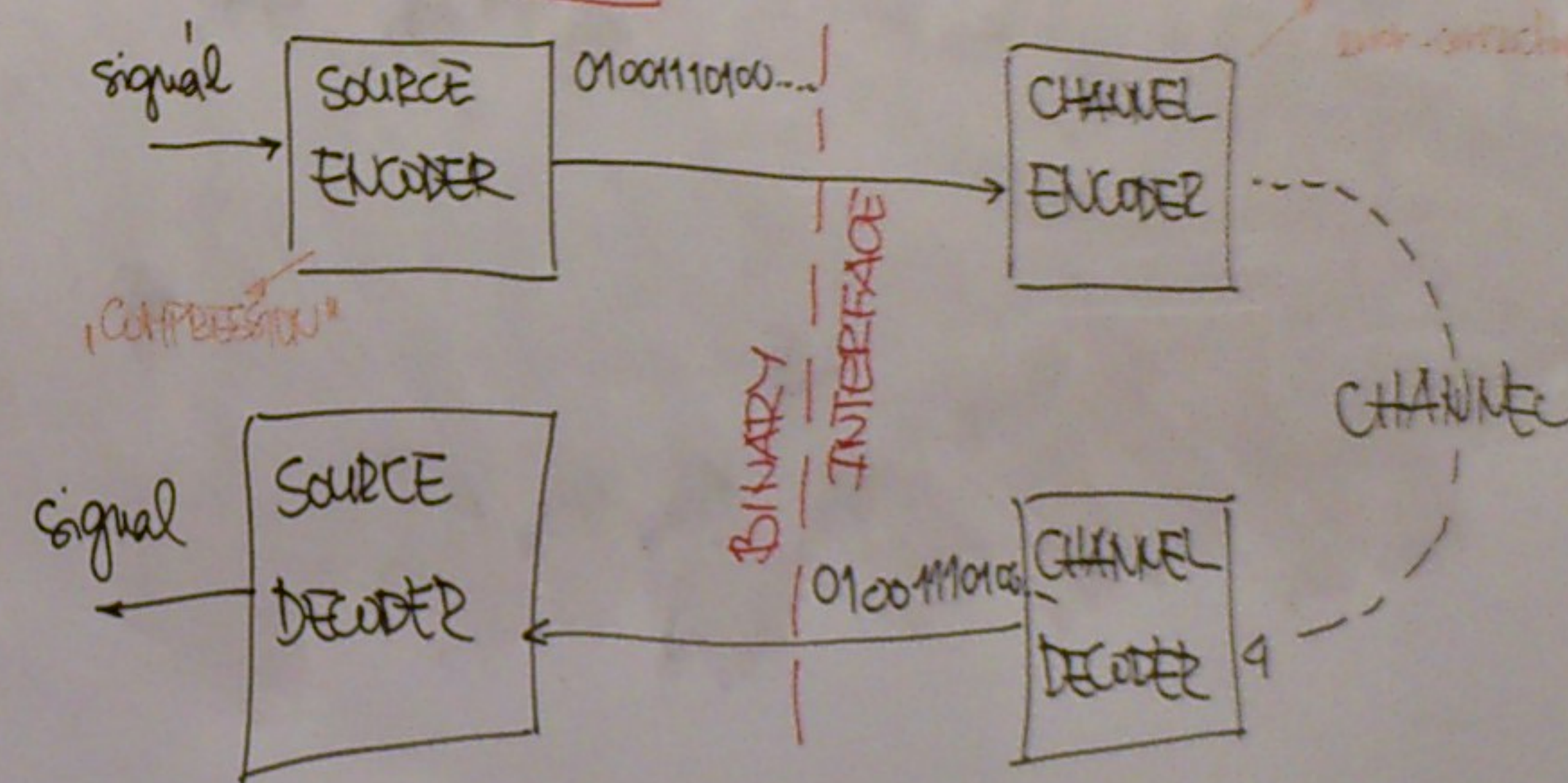
for single-source & single-receiver

veho postupně migruje:

<http://zolotarev.fd.cvut.cz/ske/>

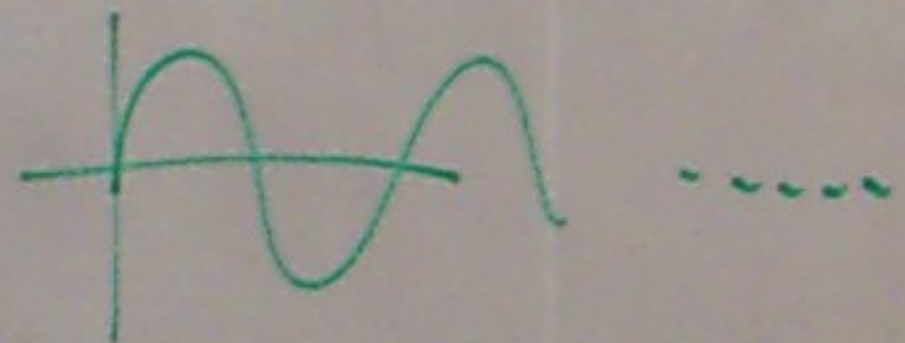
Digitální komunikace

1948 Claude Shannon: vše lze převést jako 0,1



Communication source

Nyquist: superimposed sine wave \Rightarrow Fourier analysis
Shannon: random process \Rightarrow **information theory**

Example: $f(t) = a \cdot \sin(\omega t + \phi)$ 
 \hookrightarrow Shannon: (a, ω, ϕ)

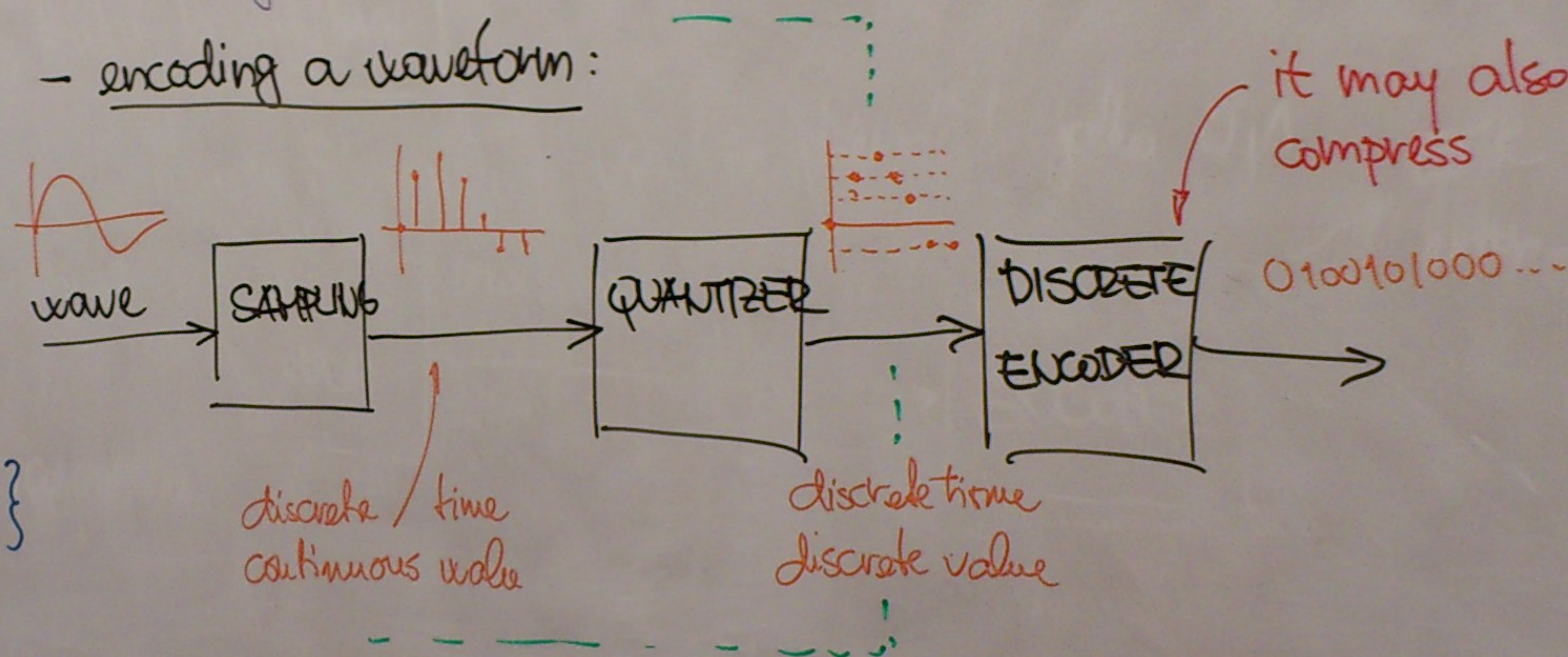
ENTROPY in bits

Random process generated by a source $X = \{x_1, x_2, x_3, x_4, \dots, x_n\}$
with probabilities $p(x_1), p(x_2), p(x_3), \dots$

$$H(X) = - \sum_{i=1}^n p(x_i) \cdot \log_2(p(x_i)) \rightarrow \text{number of bits necessary to represent the source}$$

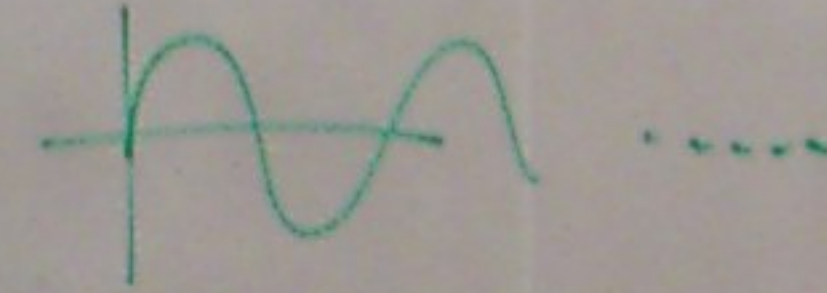
SOURCE ENCODING

- OSI network model
 \hookrightarrow layers & interfaces
- encoding a waveform:



Communication source

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Example: Fair dice $p(x_i) = 1/6$ $X = \{1, 2, 3, 4, 5, 6\}$
 $H(X) = - \sum_{i=1}^6 \frac{1}{6} \log_2 \frac{1}{6} = - \log_2 \frac{1}{6} = -(-2.585)$
 \hookrightarrow i need 3 bits to represent numbers 1...6.

Shannon's coding theorem

Source with entropy $H(X)$ producing r symbols/sec
 \rightarrow source speed: $V(X) = H(X) \cdot r$ [bps]

Communication channel with capacity C [bps]

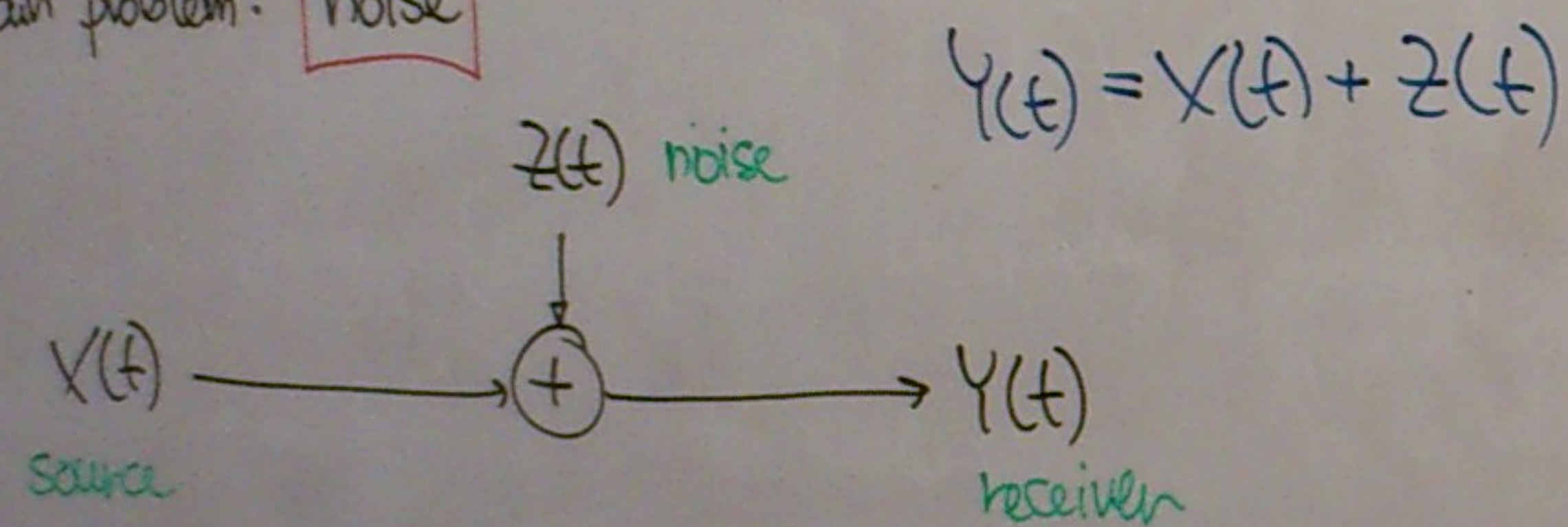
a) $V(X) > C \Rightarrow$ i can not transmit anything

b) $V(X) < C \Rightarrow V(X)$ can be transmitted with an arbitrary low error

c) $V(X) = C$ i cannot make guarantees about the error

CHANNEL CODING

The channel is given; we have no influence over it
converting 0's and 1's \rightarrow modulation
main problem: noise



AWGN channel (Additive white Gaussian noise)

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