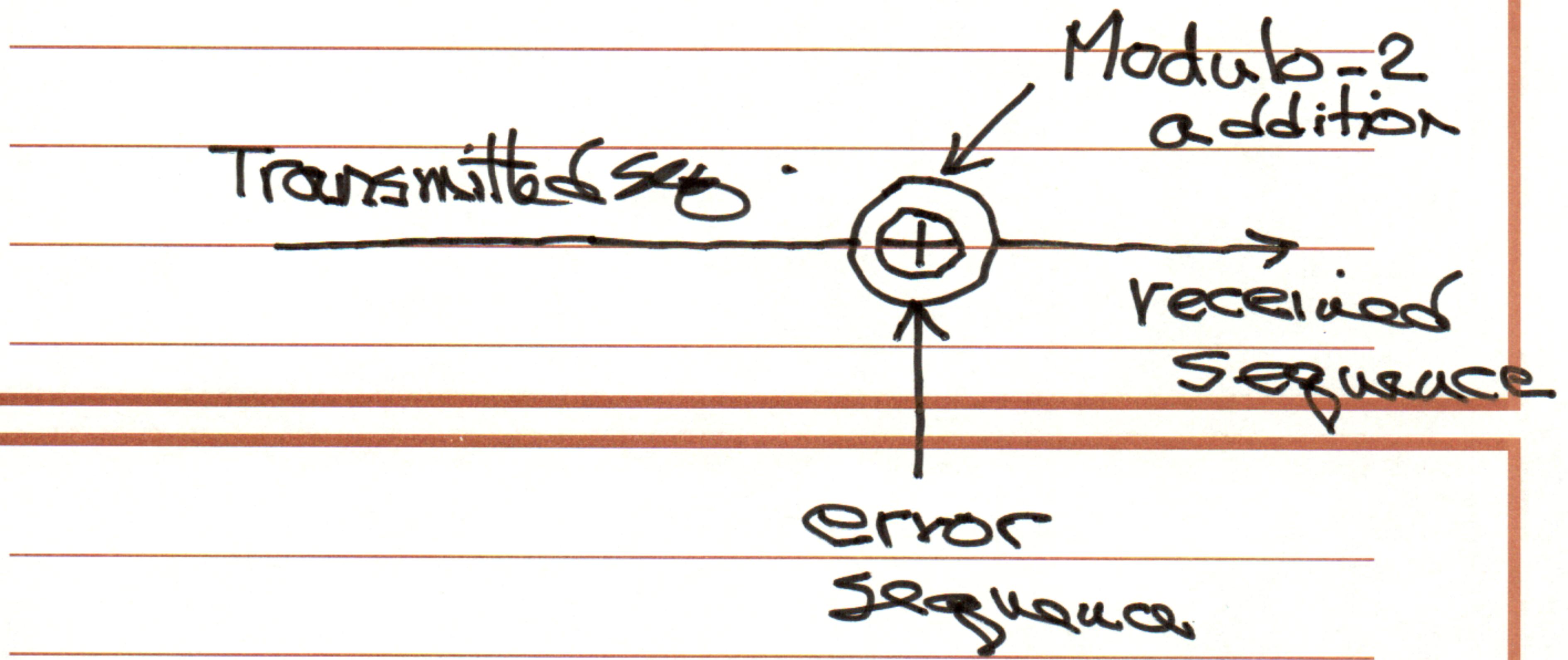
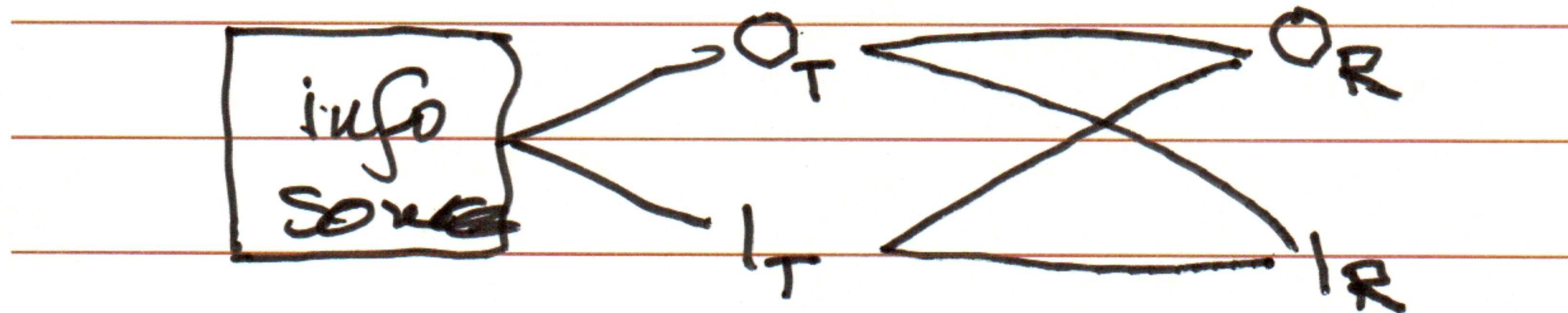


*Parker* | o||||| o||||| o||| |

# Error Detection



Modulo 2 arithmetic

there are two numbers 0, 1

$$(4)_{\text{Mod}2} = 0$$

$$(13)_{\text{Mod}2} = 1$$

$$(-3)_{\text{Mod}2} = 1$$

## mod 2 addition

$$0+0 = 0$$

in Binary  
addition

$$0+1 = 1$$

$$1+0 = 1$$

$$1+1 = 10$$

$$1+1 = 0$$

EX-OR

multiplication Mod 2

$$0 \cdot 0 = 0$$

$$0 \cdot 1 = 0$$

$$1 \cdot 0 = 0$$

$$1 \cdot 1 = 1$$

AND gate

T/X ~~msg~~ 1011011

R/X ~~msg~~ 1101001

error ~~msg~~ 0110010

aside

Single Parity check

even parity      odd parity

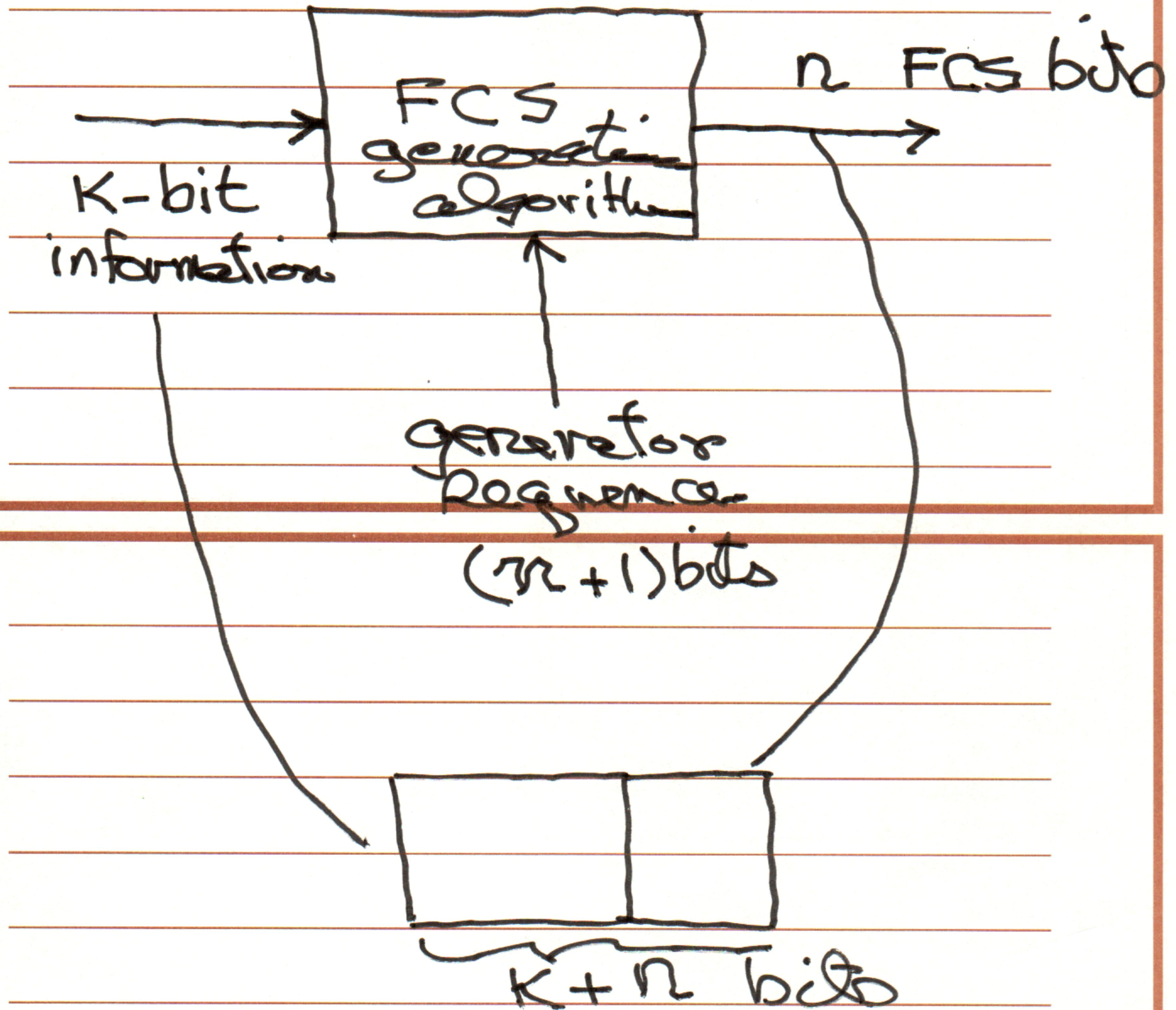
all even parity  
11011001 parity bit  
111p11000  
-111101 -  
11101001

$$\text{code efficiency} = \frac{7}{8} \times 100\% \\ \approx 87\%$$

$$\approx \frac{2000}{2016} = 99\%$$

# Frame check Sequence

@ Sender

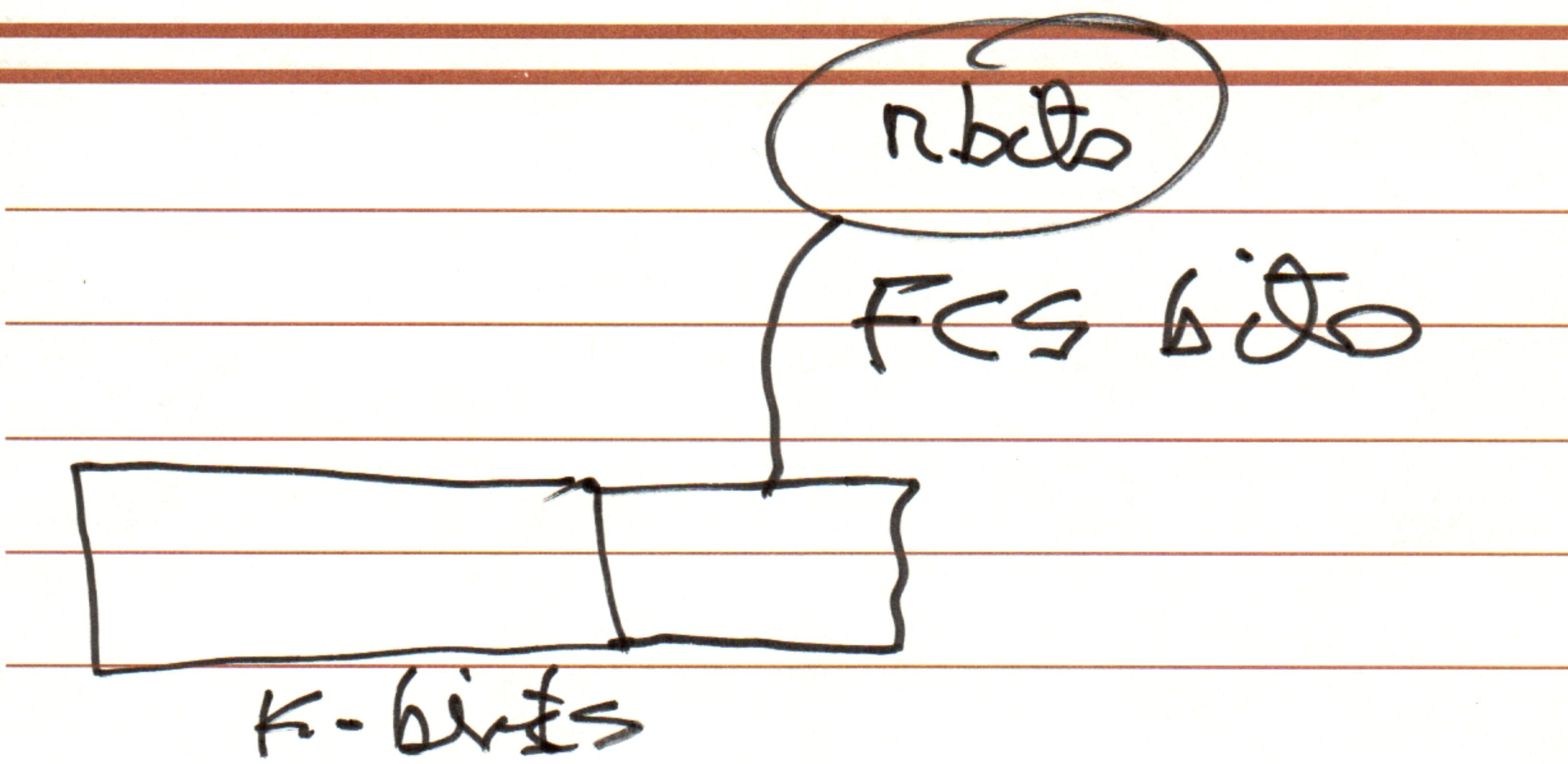


Algorithm

$(n+1)$   
generator  
sequence



remainder →



Polydivision

$$x^4 x^3 x^2 x^1 x^0$$

10111

~~$$x^4 + x^3 + x^2 + x + 1$$~~

$$x^4 + x^2 + x + 1$$

101101010

$$x^8 + x^6 + x^5 + x^3 + x$$

Back to our example

$$\begin{array}{r} x^3 + x \\ \hline x^3 + x + 1 \quad | \quad x^6 + x^3 \\ \hline x^6 + x^4 + x^3 \\ \hline x^4 \\ x^4 + x^2 \\ \hline x^2 + x \end{array}$$

110

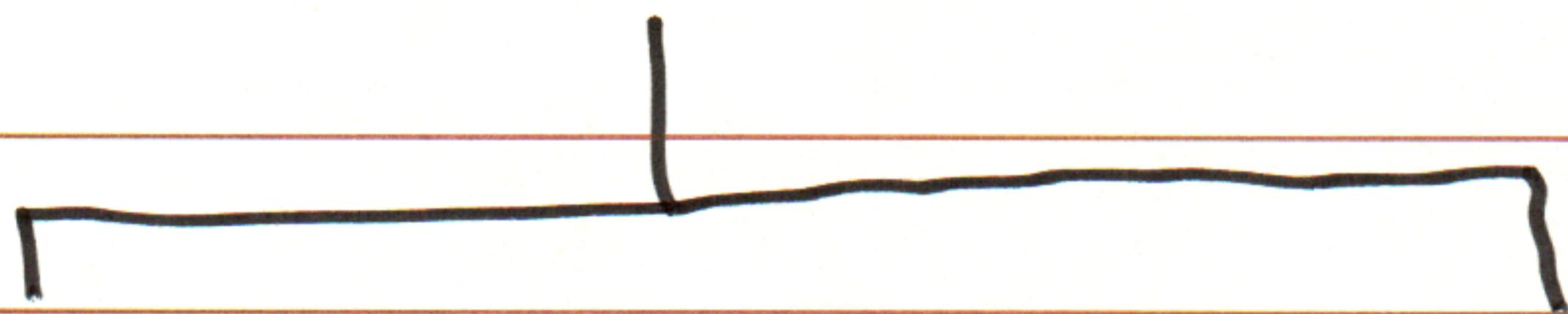
@ receiver

Receiver receives  $K+n$  bits

generated  
frame

$K+n$   
bits

Receiver



Zero



No errors  
were detected

NOT Zero



Frame is  
in error

## Stop & Wait

Here the Sender is allowed to transmit one frame at a time and must wait for an ACK before he can send another frame (No pipelining)

