Design of MBLT code with decreased maximum of degree at the low overhead

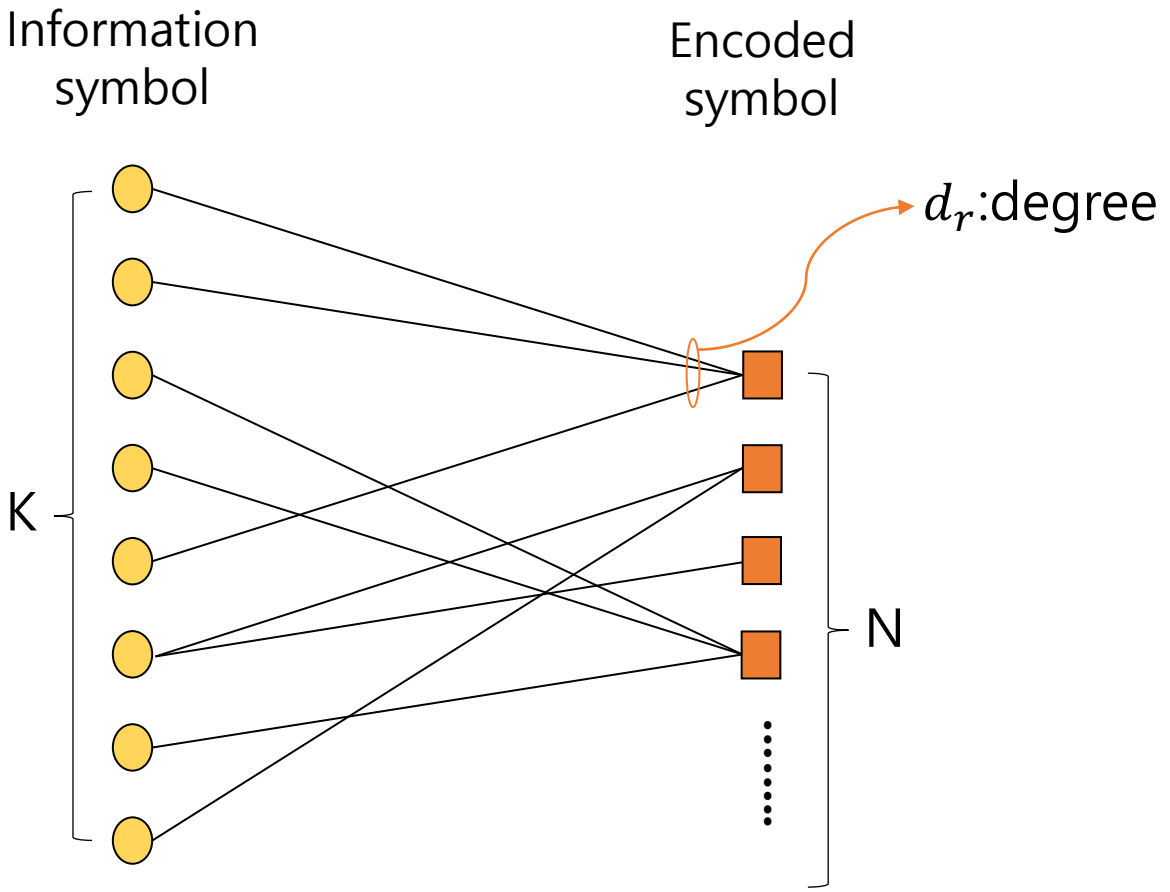
Zhi Jing, Inseon Kim, and Hong-Yeop Song

Yonsei University

Contents

- Preliminaries
  - LT code
  - MBLT code
- Motivation
- α-MBLT code
- Simulation result

LT code

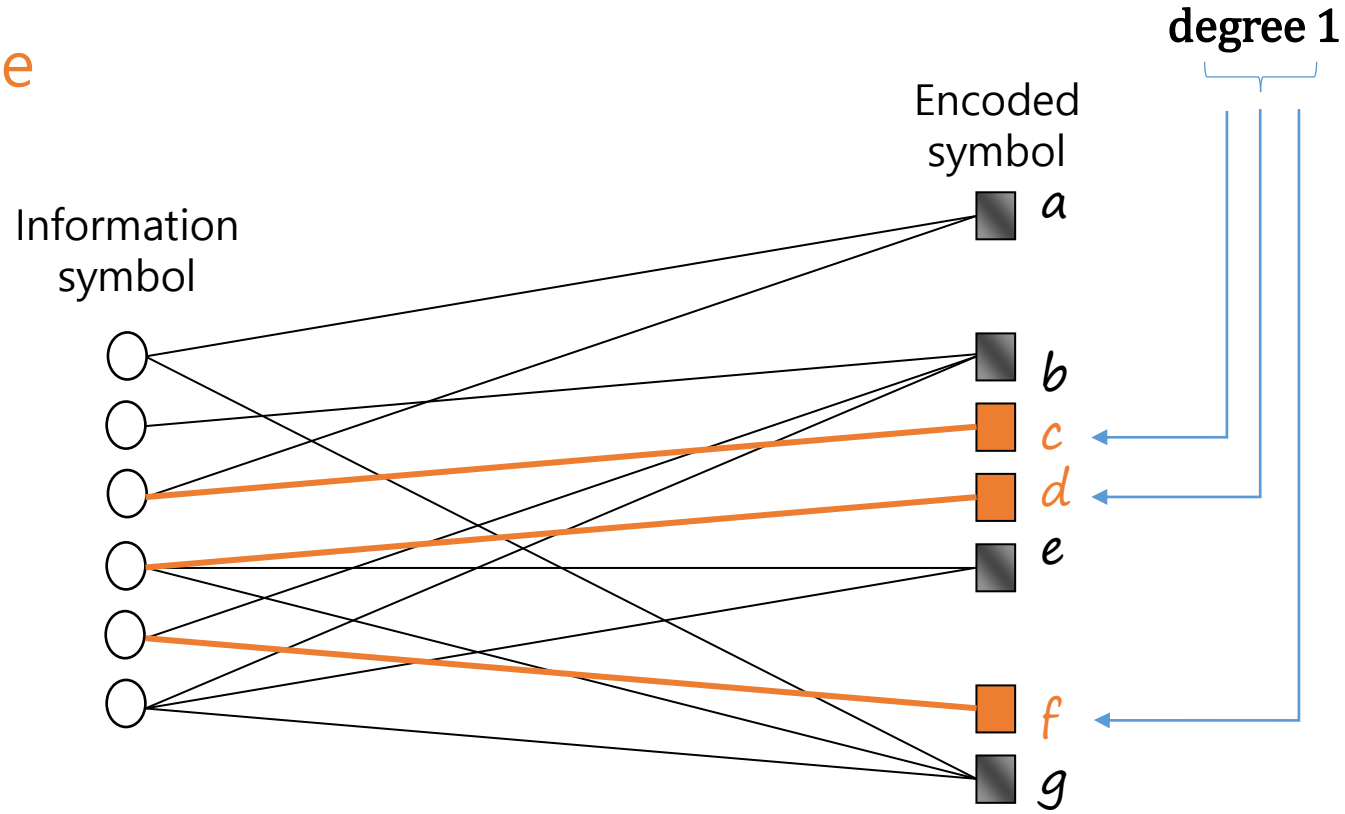


γ : overhead ($\gamma = \frac{N-K}{K}$)

$\mu(x)$: the right degree distribution (RDD)

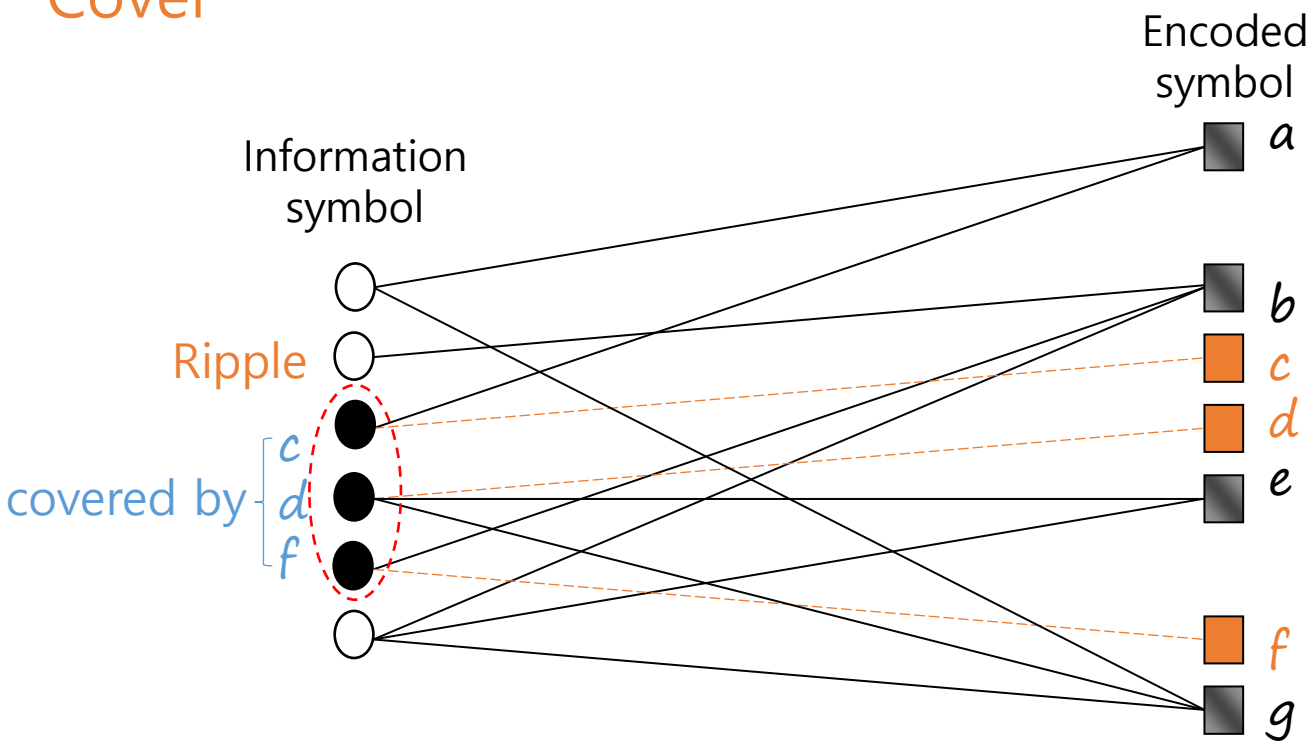
Decoding

1. Release



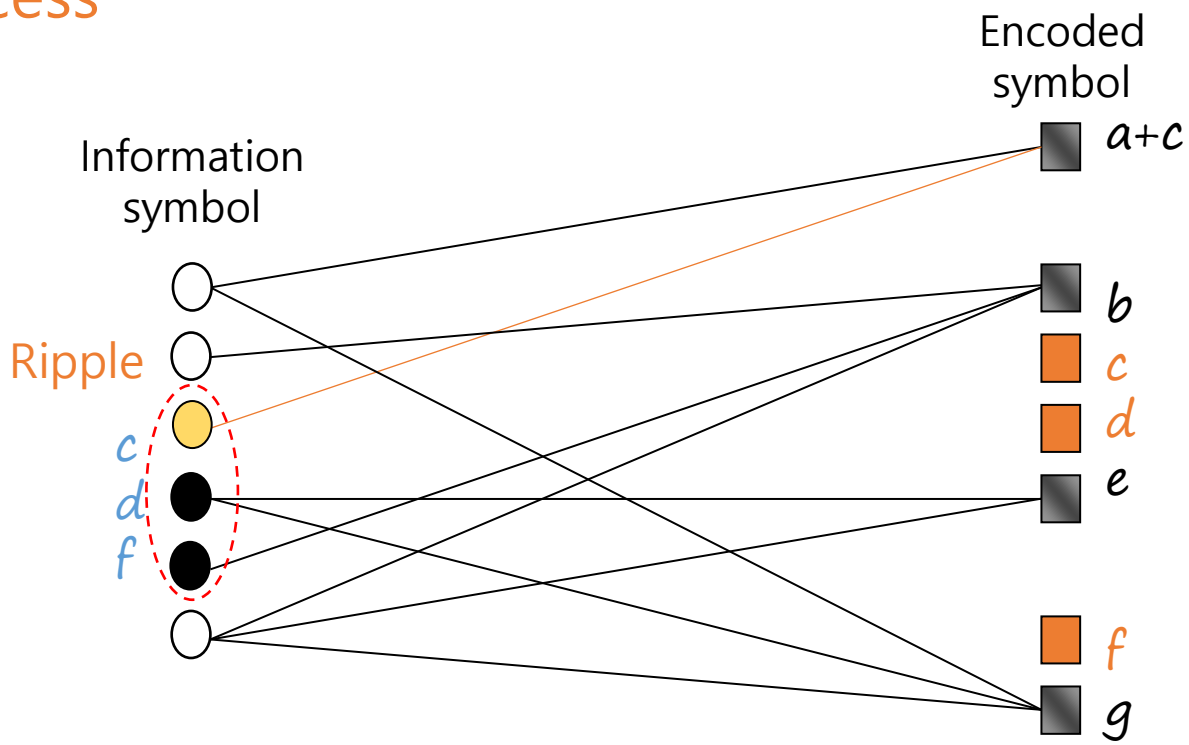
Decoding

2. Cover



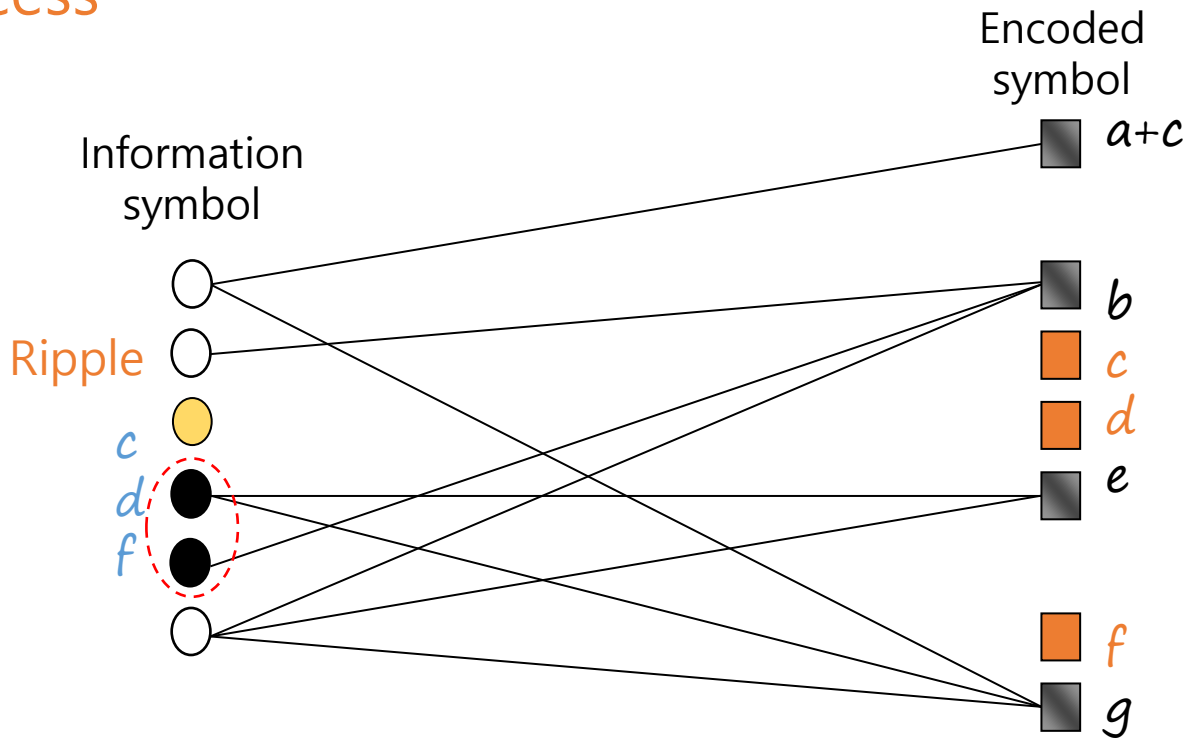
Decoding

3. Process



Decoding

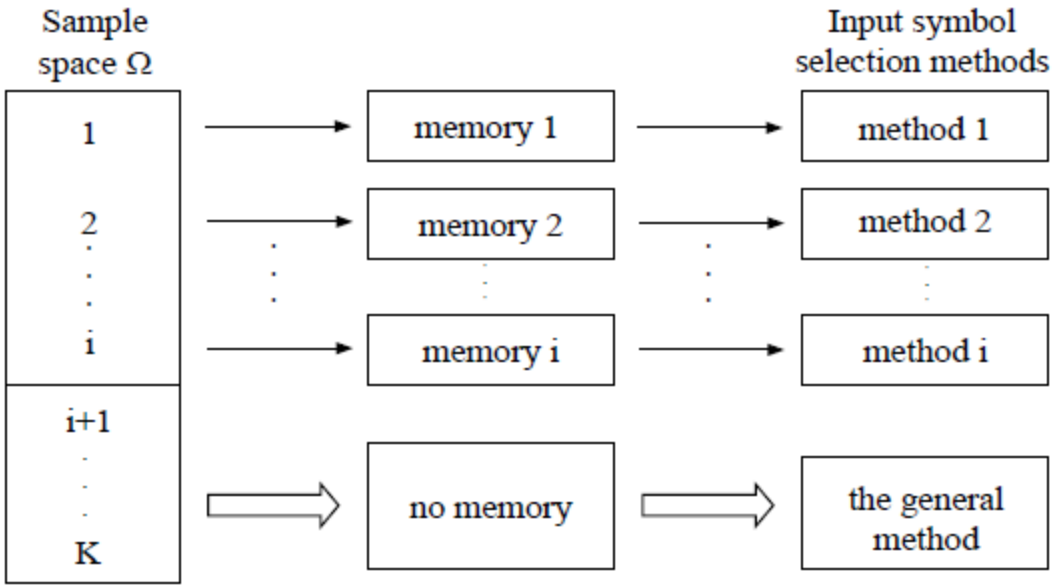
3. Process



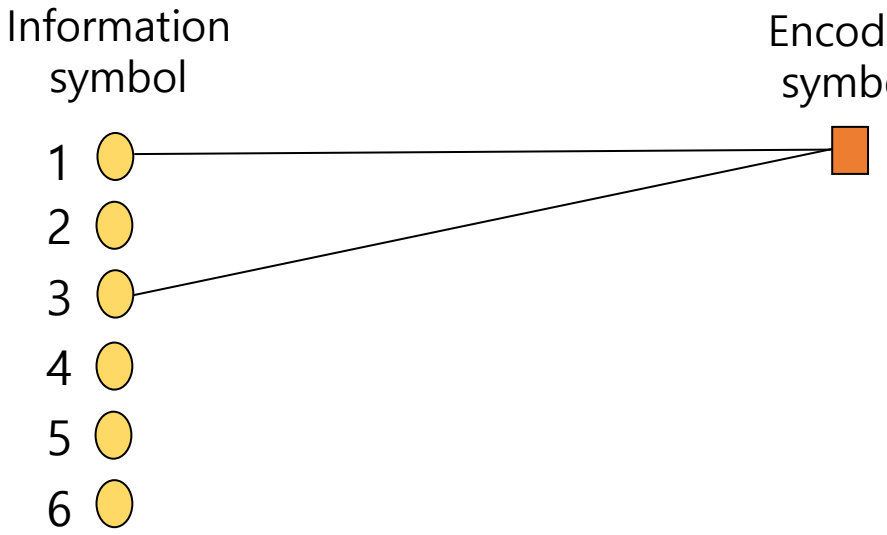
- The decoding process continues by iterating the above three step.

Memory-based LT code

- i^{th}-order MBLT encoder

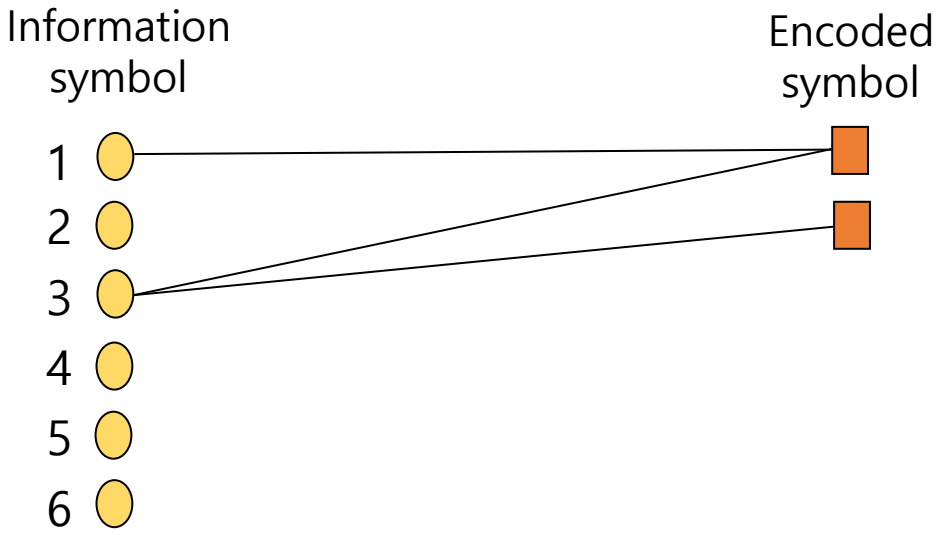


1^{st}-order MBLT code



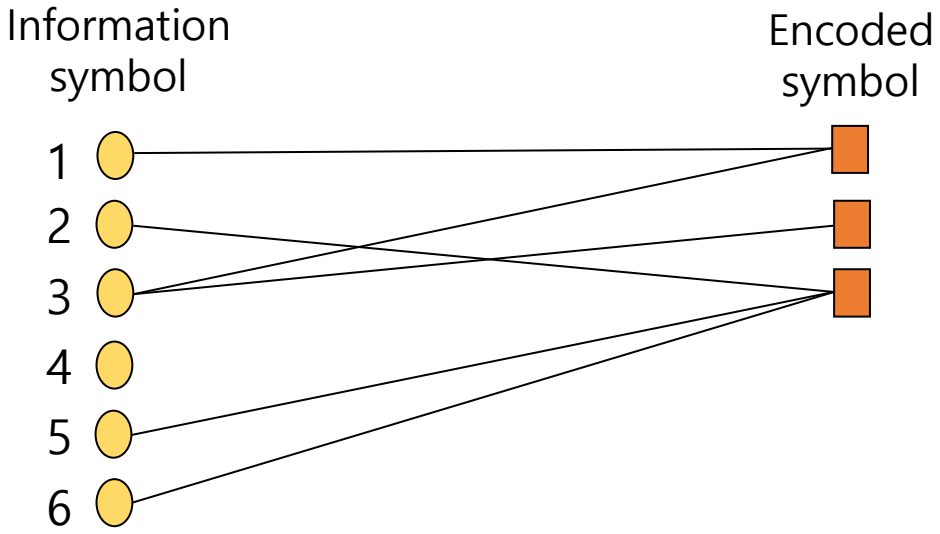
i-th encoding process \ No. symbol	1	2	3	4	5	6	Picked symbol at d_r=1
1	1	0	1	0	0	0	

1^{st}-order MBLT code



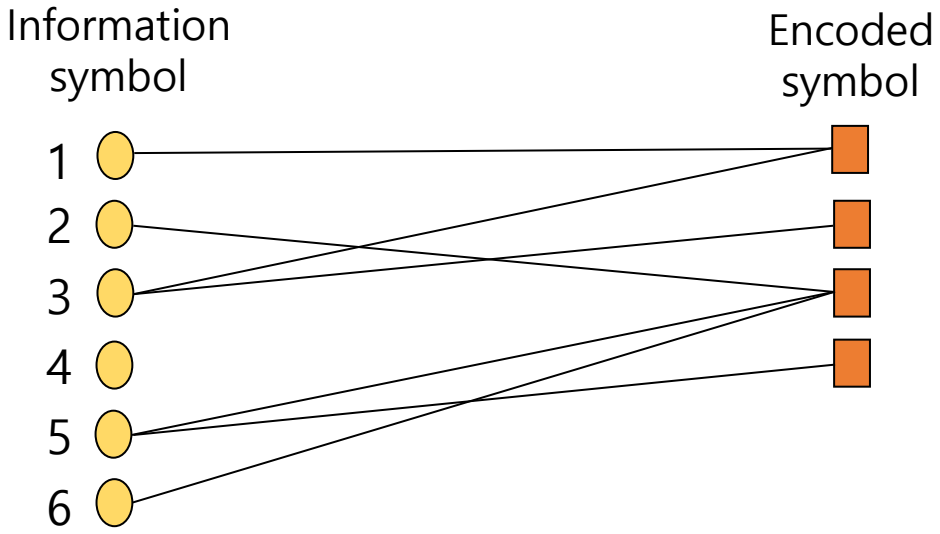
i-th encoding process \ No. symbol	1	2	3	4	5	6	Picked symbol at d_r=1
1	1	0	1	0	0	0	
2	1	0	2	0	0	0	3

1^{st}-order MBLT code



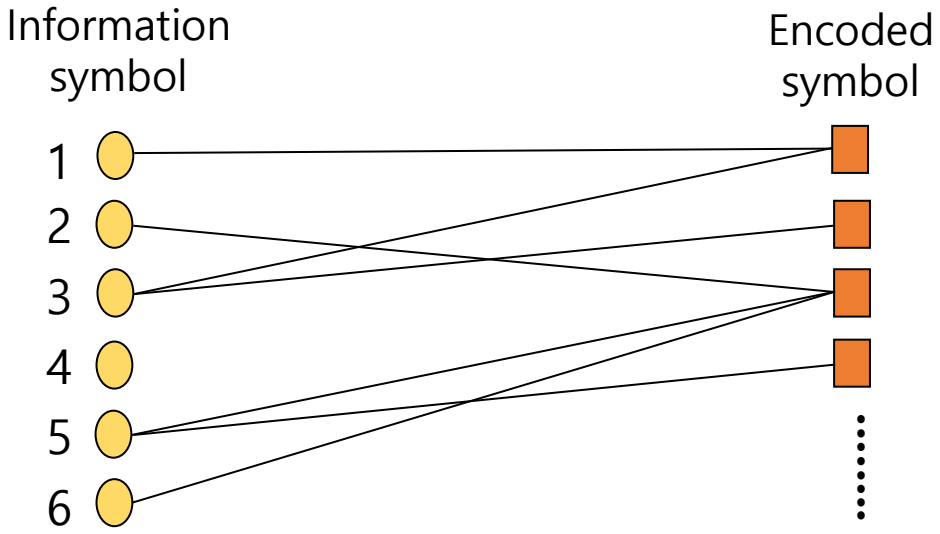
No. symbol / i-th encoding process	1	2	3	4	5	6	Picked symbol at d_r=1
1	1	0	1	0	0	0	
2	1	0	2	0	0	0	3
3	1	1	2	0	1	1	

1^{st}-order MBLT code



i-th encoding process \ No. symbol	1	2	3	4	5	6	Picked symbol at d_r=1
1	1	0	1	0	0	0	
2	1	0	2	0	0	0	3
3	1	1	2	0	1	1	
4	1	1	2	0	2	1	2

1^{st}-order MBLT code



i-th encoding process \ No. symbol	1	2	3	4	5	6	Picked symbol at d_r=1
1	1	0	1	0	0	0	
2	1	0	2	0	0	0	3
3	1	1	2	0	1	1	
4	1	1	2	0	2	1	2
⋮							

1^{st}-order MBLT code

Encoding algorithm:

1. Randomly sample a degree d_r;
2. If $d_r = 1$, pick the information symbol with the highest instantaneous degree without replacement;
   If $d_r \neq 1$, pick d_r different information symbols among K information symbols at random with replacement;
3. Generate the encoded symbol by bitwise XOR operation of the d_r picked information symbols;
4. Repeat until generating the N encoded symbols.

- instantaneous degree (of left degree distribution (LRR)),
  - ✓ which is the degree of the information symbols at the current encoding process

Motivation

The value of λ	large	small
	Good performance	Poor performance
The probability of		

For LT code:

- the K information symbols can be recovered from any N $(N = K + O\left(\sqrt{K}In^2\left(\frac{K}{\delta}\right)\right))$ encoded symbols with probability $1 - \delta$.

the encoded symbol with low degree:

- get started and keep going the decoding process.

the encoded symbol with high degree:

α-MBLT code

- decrease the maximal degree D_{max} of the encoded symbol.

- α: determine the D_{max}, and $0 < \alpha \leq 1$,

$$\sum_{x=1}^{D_{\max}-1} \mu(x) < \alpha \leq \sum_{x=1}^{D_{\max}} \mu(x),$$

where $\mu(x)$ is the robust degree distribution of LT code.

α-MBLT code

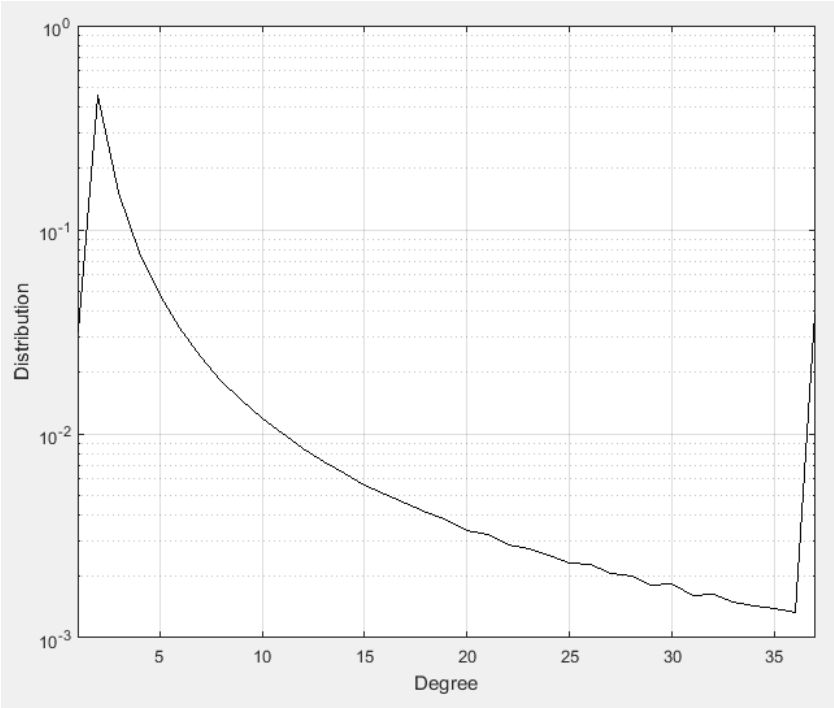
- The new right degree distribution $\lambda(x)$ is:

$$\lambda(x) = \begin{cases} \mu(x), & x = 1, 3, 4, \ldots, D_{\max} \\ \mu(x) + \sum_{i=D_{\max}+1}^{K} \mu(i), & x = 2 \\ 0, & x = D_{\max} + 1, \ldots, K \end{cases}$$

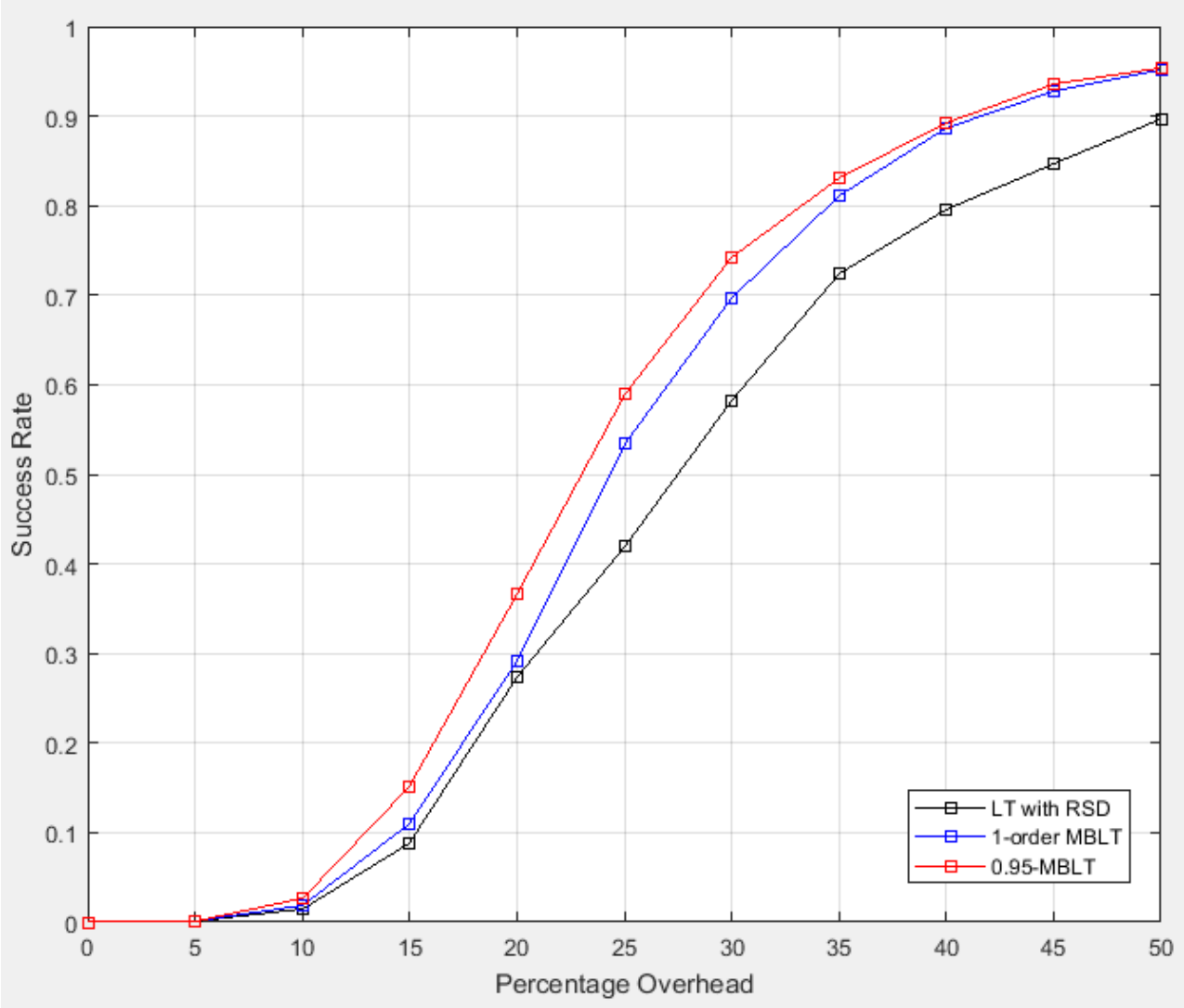
where $\mu(x)$ is the robust Soliton distribution (RSD).

Simulation result ($\alpha = 0.95$)

Degree distribution:



Simulation result ($\alpha = 0.95$)



Question?