Yonsei University

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수정된 Plotkin-Type LDPC 부호를 이용한 비 균등 오류 보호 방법

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I. 서 론

Unequal Error Protection (UEP)

Most(More) Significant Bits (MSB)

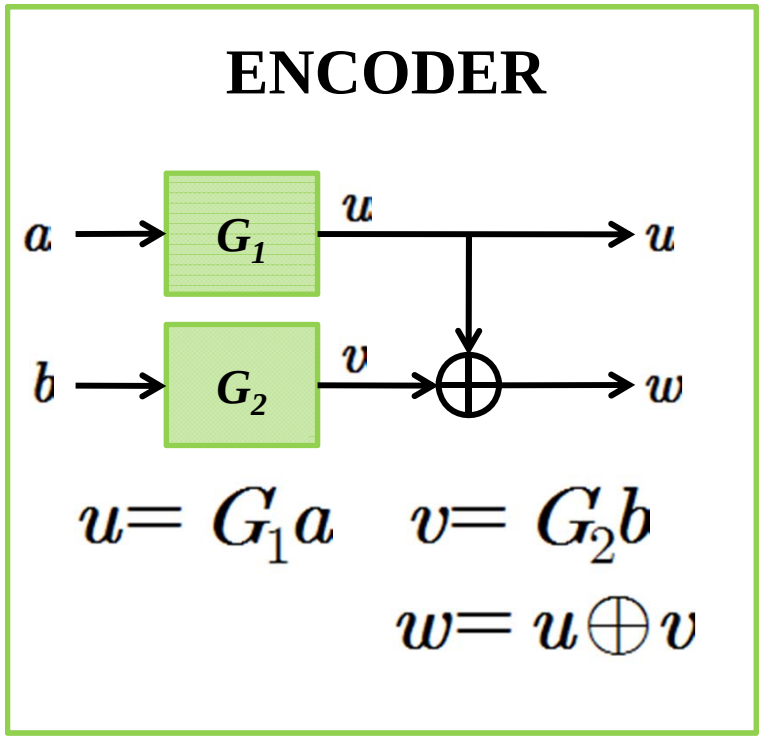
Least Significant Bits (LSB)

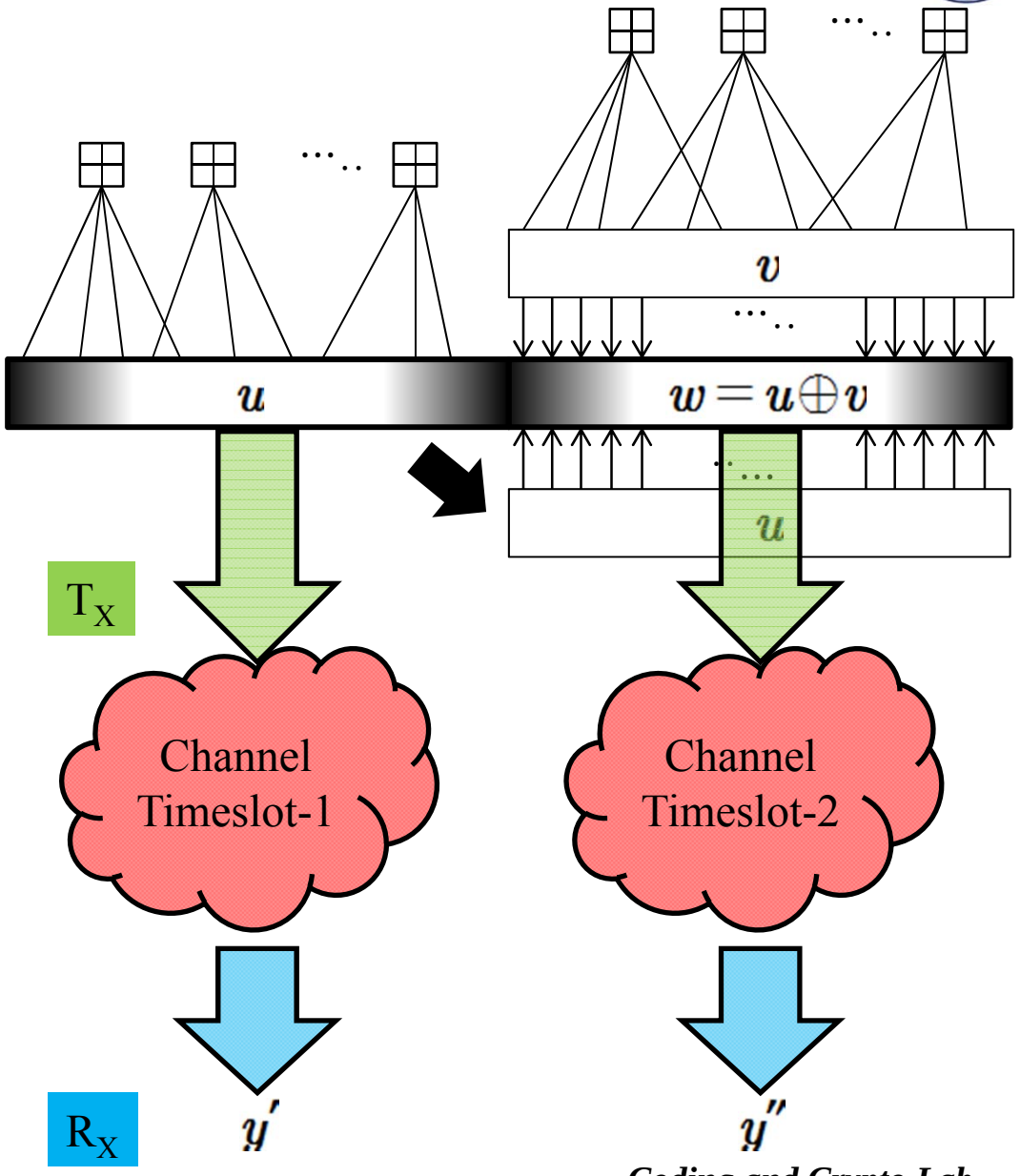
Two Methods

Irregular LDPC UEP

Plotkin-Type UEP

II. 기존 Plotkin-Type LDPC UEP 모델





II. 기존 Plotkin-Type LDPC UEP 모델

Multistage(MS) Decoding

1. Calculate LLR of $\boldsymbol{v}$

   $L_i^v = \tanh^{-1}\left(\tanh\left(L_i^{y'}\right)\tanh\left(L_i^{y''}\right)\right)$

2. LSB($\boldsymbol{v}$) Decoding
   - output : $\hat{v}_i = (-1)^{v_i}$

3. Calculate LLR of $\boldsymbol{u}$

   $L_i^u = L_i^{y'} + \hat{v}_i L_i^{y''}$

4. MSB($\boldsymbol{u}$) Decoding
   - output : Extrinsic LLR L_i^u

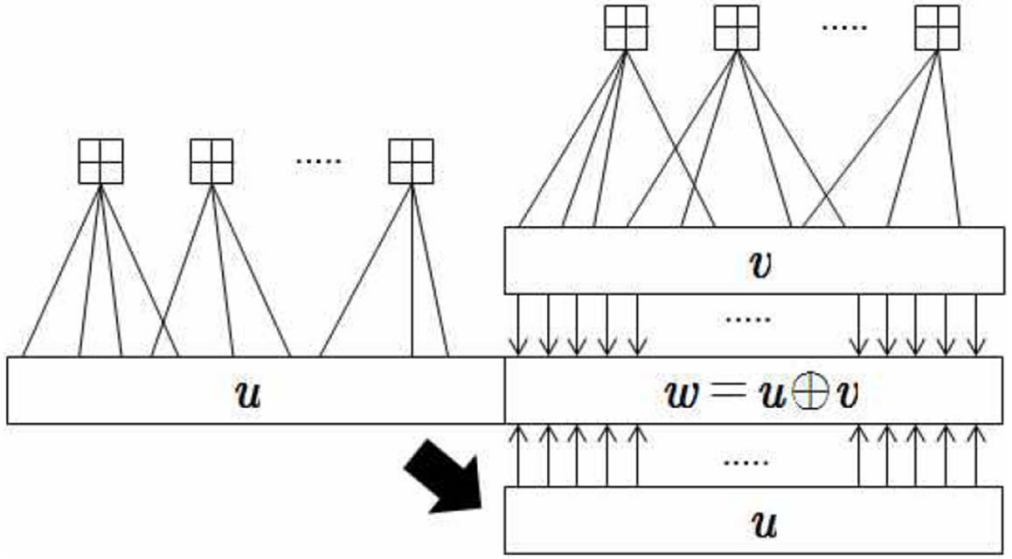
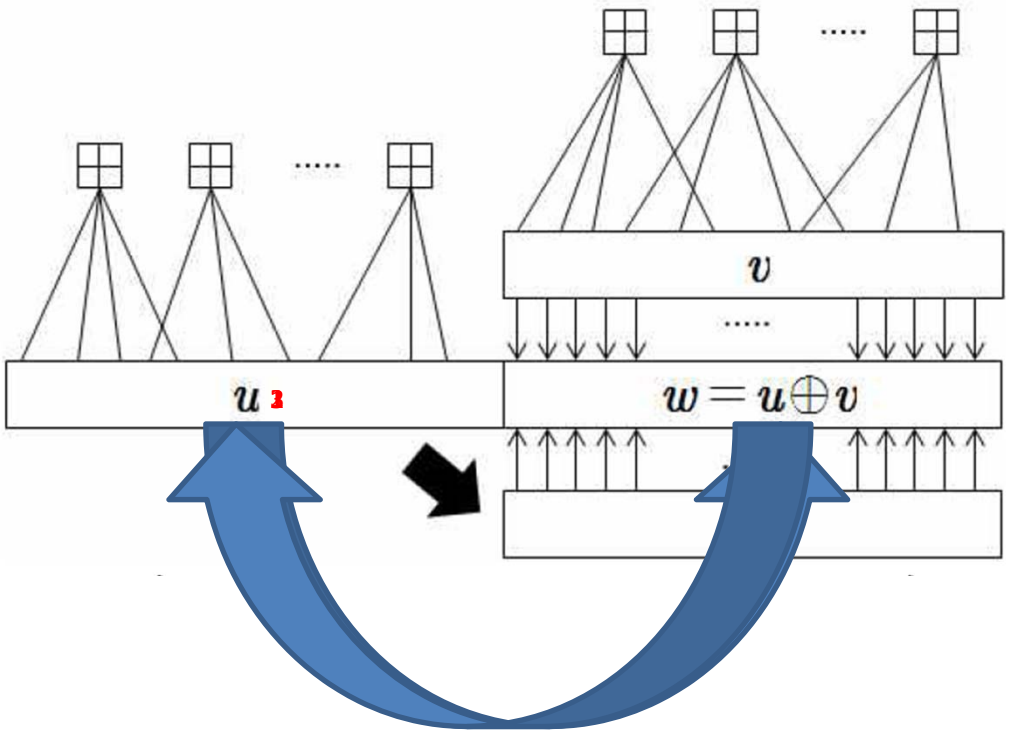


그림 1. 기존 Plotkin-Type LDPC UEP 모델

II. 기존 Plotkin-Type LDPC UEP 모델

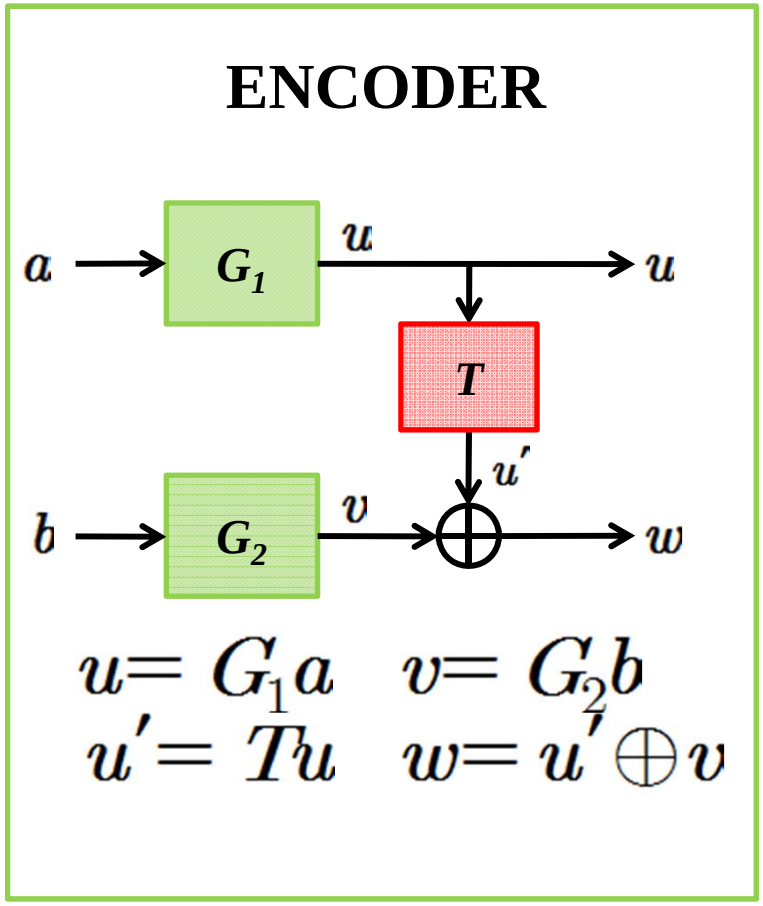
Multiround(MR) Decoding

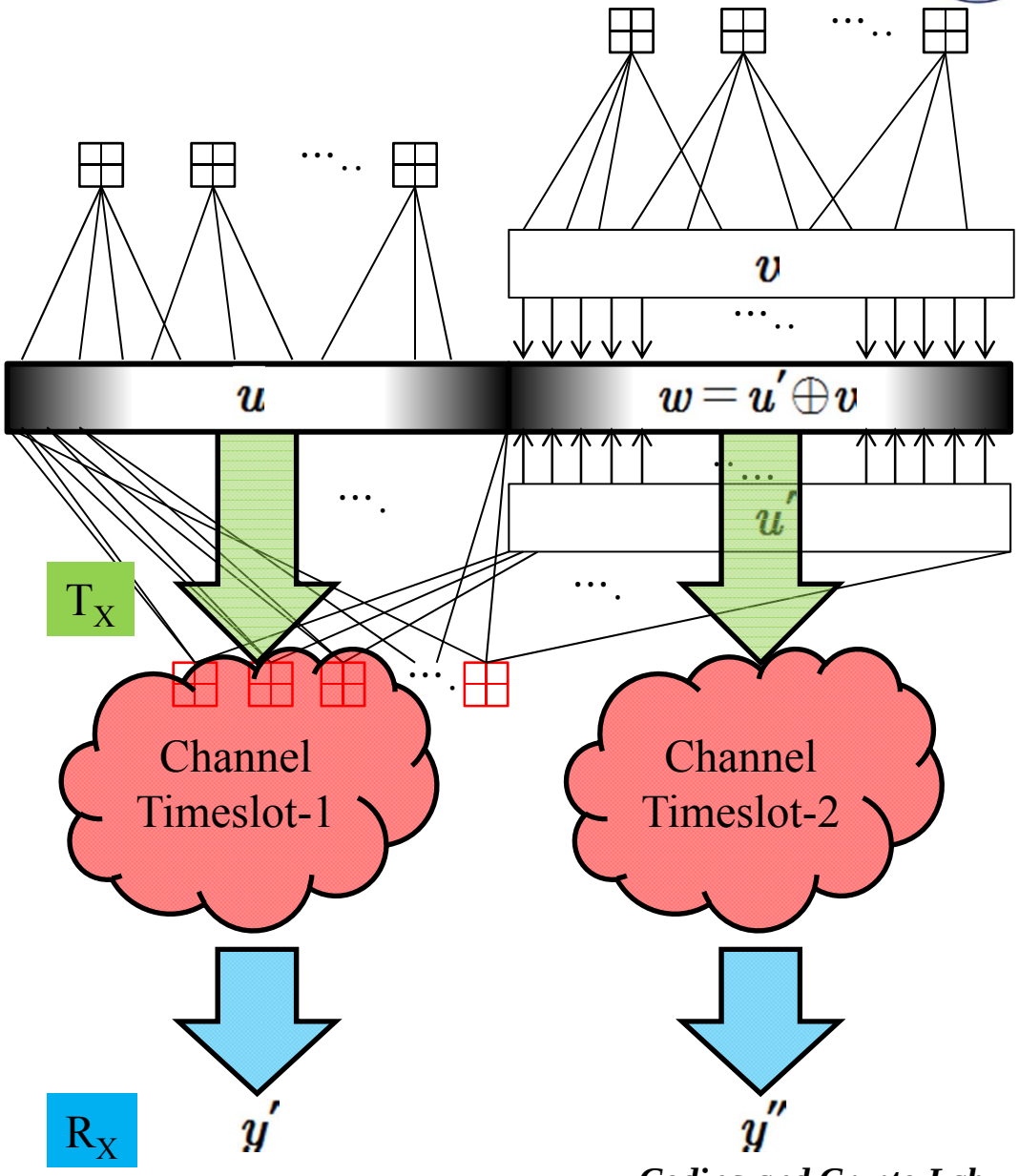
1. r = 1
2. while(r < Max_Round)
   a. MS Decoding for u & v
      $L_i^{u_r} \leftarrow L_i^{u}$
   b. $L_i^{y'} \leftarrow L_i^{u_r}$
   c. r++



3rd Round

III. 제안하는 Plotkin-Type LDPC UEP 모델





III. 제안하는 Plotkin-Type LDPC UEP 모델

Modified Multistage(MS) Decoding

1. Calculate LLR of u' (by using u)
   $L_{i,1}^{y'}, \cdots, L_{i,d}^{y'}$: d neighbors of u'_i
   $$L_i^{u'} = \tanh^{-1}\left(\prod_{k=1}^{d} \tanh\left(L_{i,k}^{y'}\right)\right)$$
2. Calculate LLR of v
   $$L_i^{v} = \tanh^{-1}\left(\tanh\left(L_i^{u'}\right)\tanh\left(L_i^{y''}\right)\right)$$
3. LSB(v) Decoding
   - output : Extrinsic LLR L_i^v
4. Calculate LLR of u' (by using v)
   $$L_i^{u'} = \tanh^{-1}\left(\tanh\left(L_i^{v}\right)\tanh\left(L_i^{y''}\right)\right)$$
5. BP Decoding of u & u'
   - output : Extrinsic LLR L_i^u

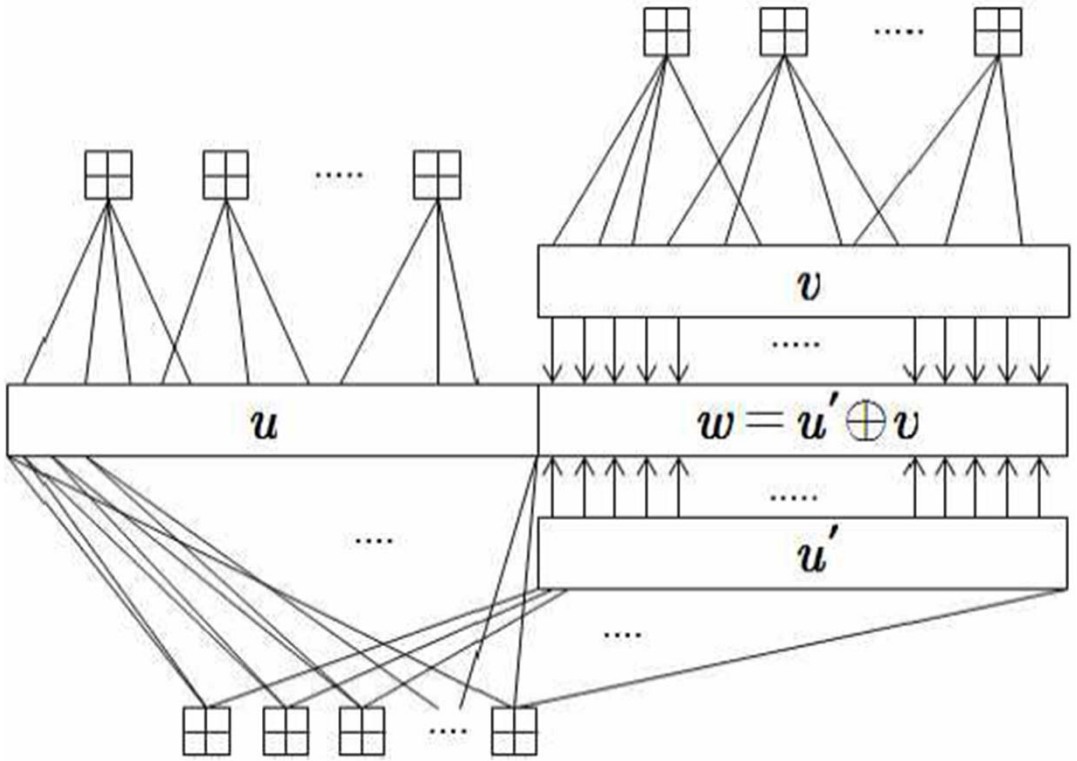
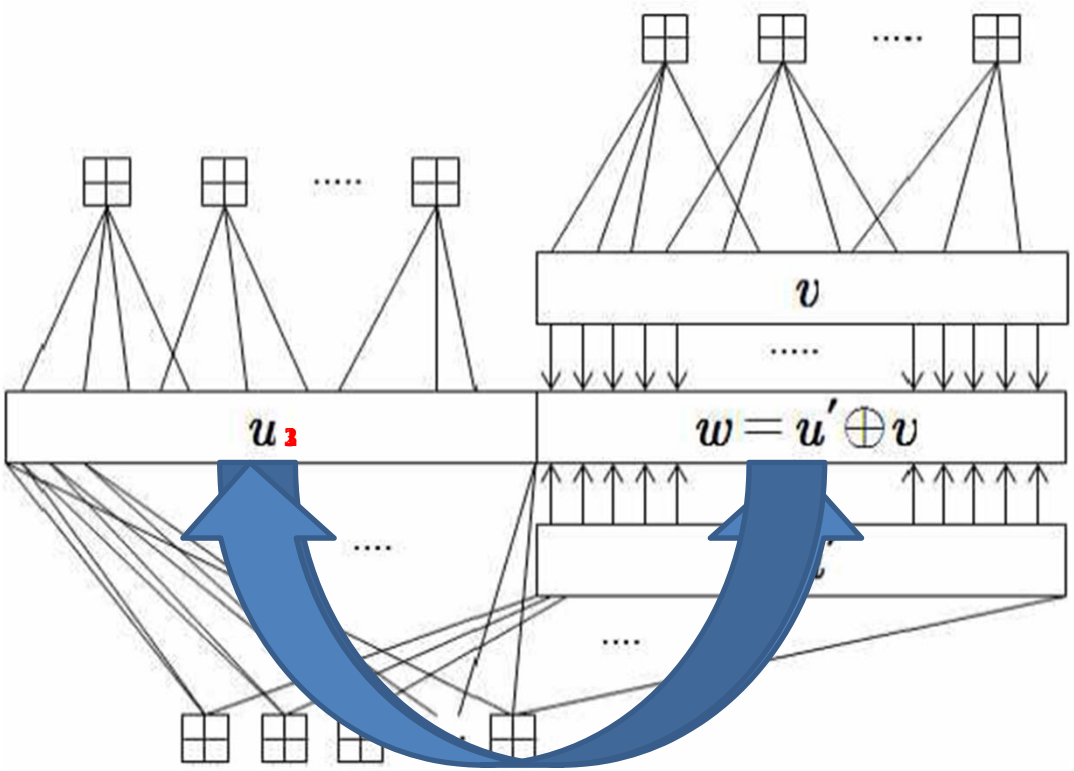


그림 2. 제안된 Plotkin-Type LDPC UEP 모델

III. 제안하는 Plotkin-Type LDPC UEP 모델

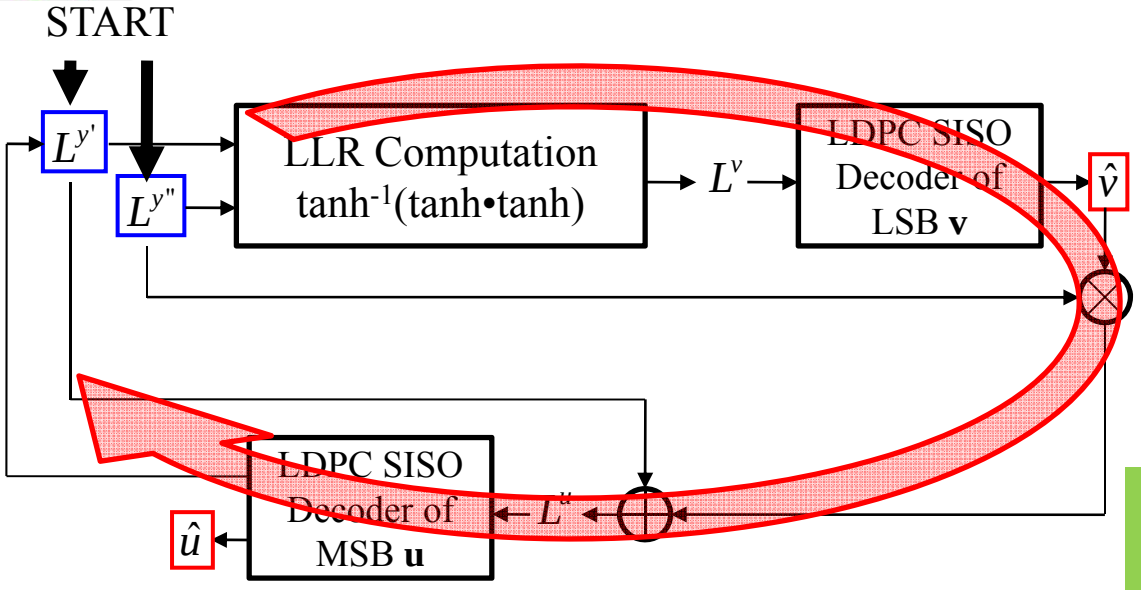
Modified Multiround(MR) Decoding

1. r = 1
2. while(r < Max_Round)
   a. Modified MS Decoding for $\boldsymbol{u}$ & $\boldsymbol{v}$
      $L_i^{u_r} \leftarrow L_i^{u}$
   b. $L_i^{y'} \leftarrow L_i^{u_r}$
   c. r++

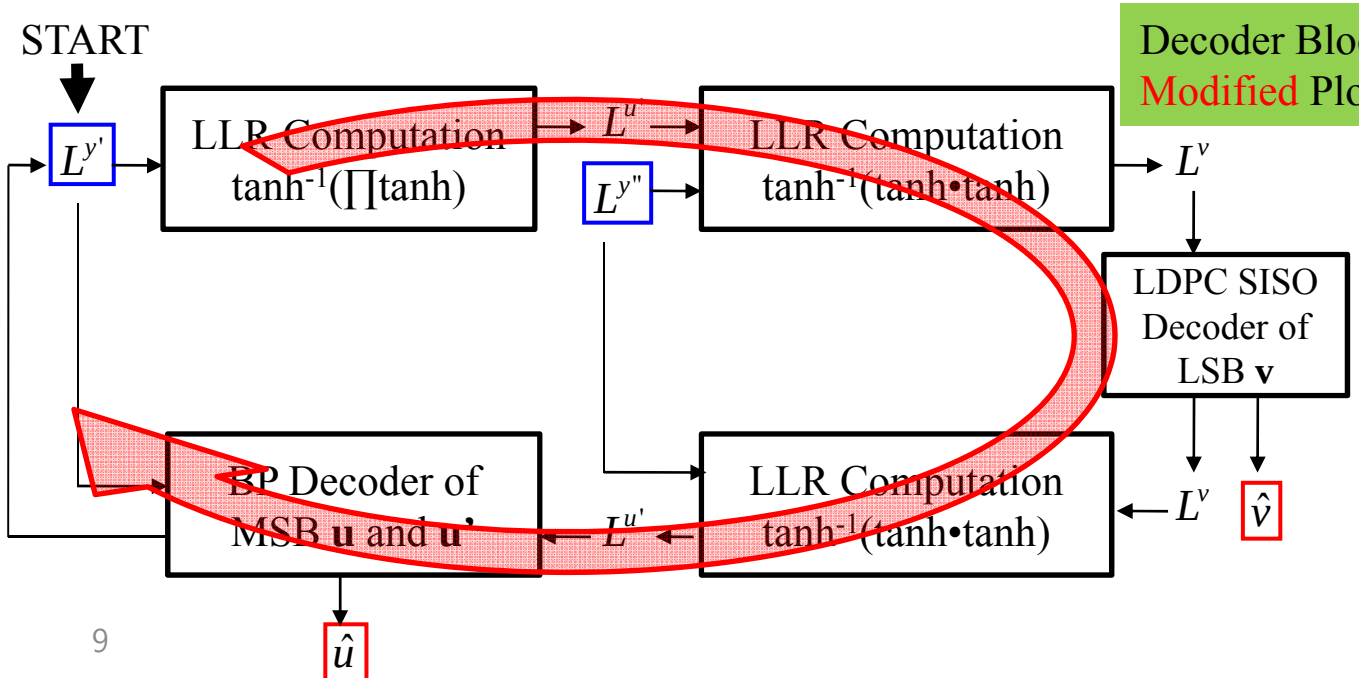


3rd Round

III. 제안하는 Plotkin-Type LDPC UEP 모델



Decoder Block Diagram of
Original Plotkin-Type LDPC UEP Codes



Decoder Block Diagram of
Modified Plotkin-Type LDPC UEP Codes

IV. 시뮬레이션 결과

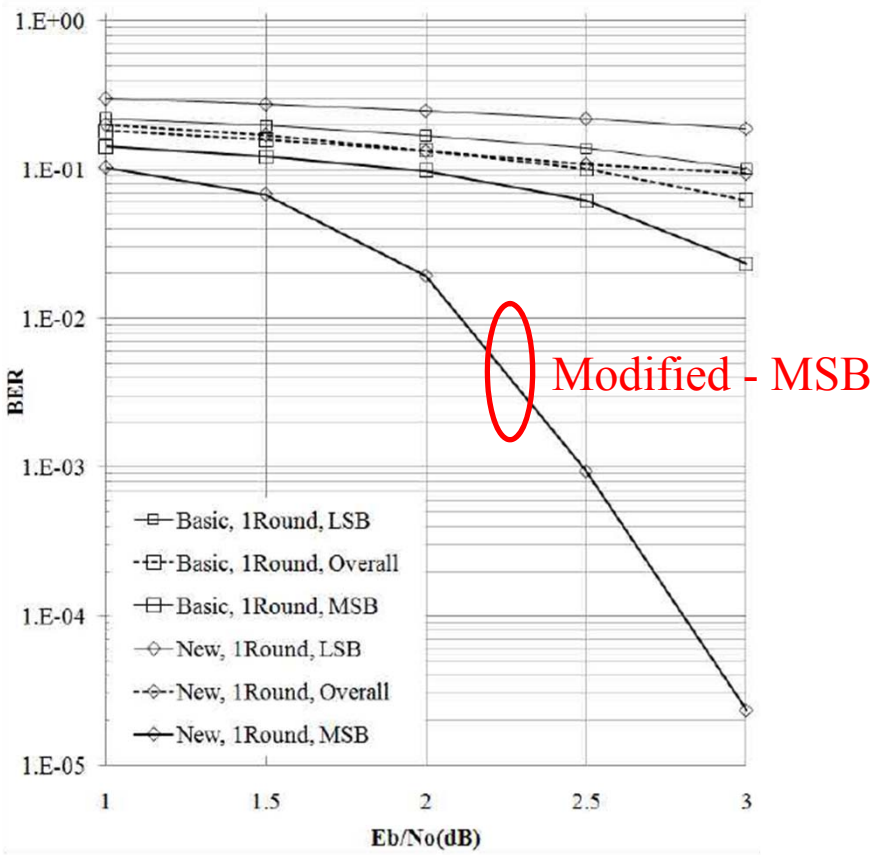


그림 3. 1번째 라운드에서의 성능 비교

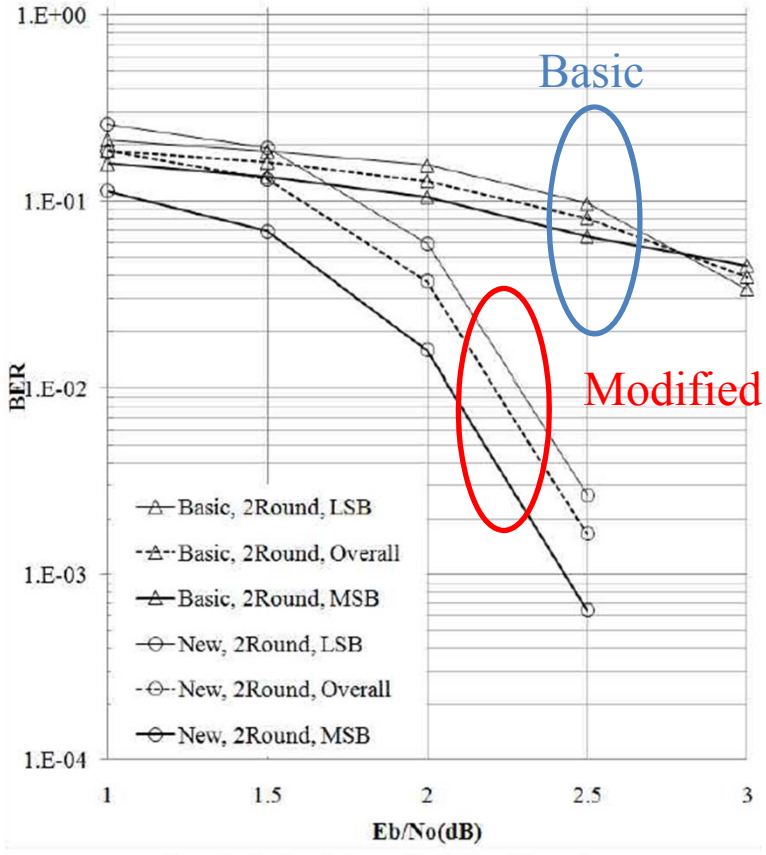


그림 4. 2번째 라운드에서의 성능 비교

MSB, LSB Component Code Specification

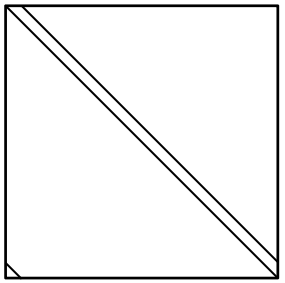
Length	1866
Code Rate	1/2
Max Iteration	15

(3,6) Regular LDPC, PEG Construction

Transform Matrix T

Dual-diagonal form

XOR neighbor 2 bits



V. 결 론

- **Basic vs Modified**
  - $u \rightarrow u'$ by using linear transform matrix **T**
  - Better BER performance
    - ✓ MSB
    - ✓ Overall!
  - If the length of MSB & LSB are different….
    - ✓ Adaptable by adjust the size of **T** to MSB & LSB length
- **Future Works**
  - Why it works?
  - What is the optimum **T**?

THANK YOU