Simulation details for 4B3T

- 3T PAM3 code-groups generated from random bit sequence by referring to Table 146-1 in IEEE 802.3 STD Clause 146
- **Ideal channel without ISI, only AWGN**
- **Symbol-wise hard decision**
- Bit de-mapping with known delimiter of the 3T code-group, by referring to Table 146-1 in IEEE 802.3 STD Clause 146
- BER calculation by comparing the transmitted with the recovered bit stream

Simulation details for 8B6T

- Disparity-bounded **6T PAM3** code-groups generated with the method in curran_3dg_01_05132024 and the upload data code-groups (82 6-tuples have disparity of 0, 174 6-tuples have positive disparity).
  - **The transmitted PAM3 signal has 430 (82+174*2) different 3T code-groups in total.**
- Adding AWGN to 6-tuple PAM5, generated from 6T PAM3 code-groups with 1+D.
- **Ideal channel without ISI, only AWGN**
- With known 6-tuple boundaries, **6 symbols are decided from the minimum Euclidean distance** $D_{n,m} = \sum_{k=1}^{k=6} \left(y_{n,k} - R_{m,k}\right)^2$.
  - k refers to the index of the symbol in the n received 6-tuple with noise y, or the m refence 6-tuple PAM5 R.
- Bit de-mapping using the relationship between 8bit and 6T PAM3 or the last five symbols of 6-tuples (PAM5).
- BER calculation by comparing the transmitted with the recovered bit stream.

Comments on 8B6T with Partial Response

- With 1+D partial response, memoryless mapping only exists between 6T PAM3 and the last 5 symbols of the 6-tuple PAM5 (see Fig.1), while the 1st PAM5 symbol depends on the last PAM3 symbol in the previous 6T code-group.
  - This indicates that 6T PAM3 or 8bit can be recovered by using only the last 5 symbols of the PAM5 tuple. However, the minimum distance between the last 5 symbols of the 6-tuple PAM5 is 1 not $\sqrt{2}$. Therefore, no performance gain.
  - There is no restriction on the 1st symbol of the 6T PAM3 code-groups, which can be 0, 1, or -1. However, the last symbol CANNOT be 0. Therefore, the 1st symbol of 6-tuple PAM5 can be 2, 1, 0, -1, or -2.
- **The number of reference 6-tuples (PAM5) used for Euclidean distance calculation will be 430 or 430*5**, depending on whether the last symbol of previous 6T code-group is used for ML detection or not.
- For each received 6-tuple with noise, every Euclidian distance calculation needs 6 multiplication. Even with 430 reference 6-tuples, 2580 multiplications are needed. **The decoding complexity is more than two times higher than digital Echo cancellation.**

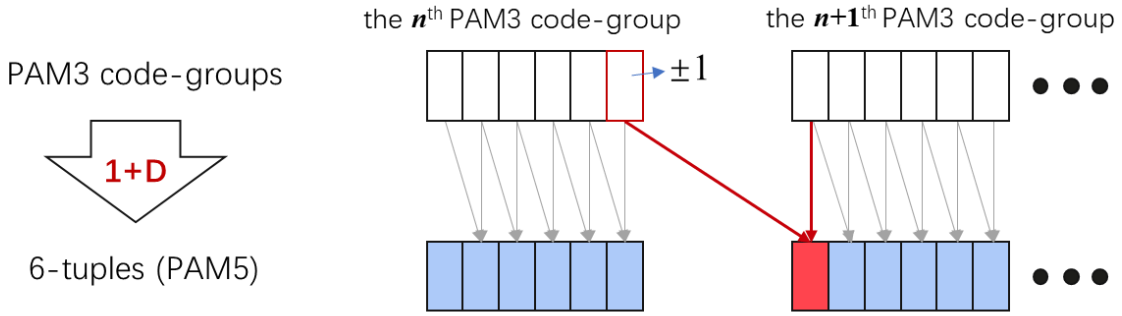

Figure 1

Performance comparison

- 4B3T has more strict disparity bounding than 8B6T, giving better low frequency suppression.
- The performance gain of 8B6T in Curran_3dg_01_06262024 is achieved by comparing simulated SNR with a calculated SNR threshold of 17.9dB.
- Nevertheless, in the case of only AWGN, simulated BER of 8B6T with partial response is worse than 4B3T. This ideal simulation shows that the theoretical SNR of 8B6T with partial response cannot be better than that for 4B3T (20.2dB).