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# Analysis and Design of Channel Interleavers for Terrestrial Broadcast

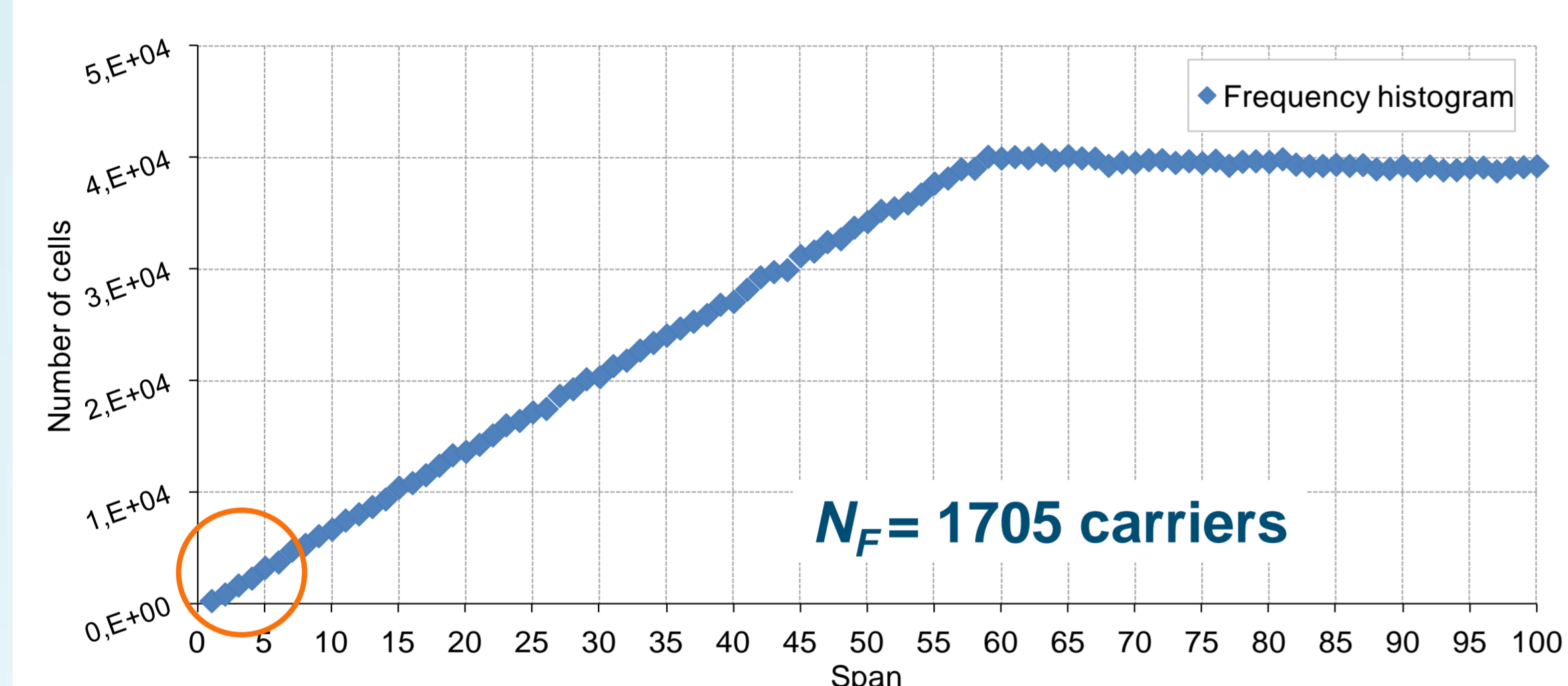
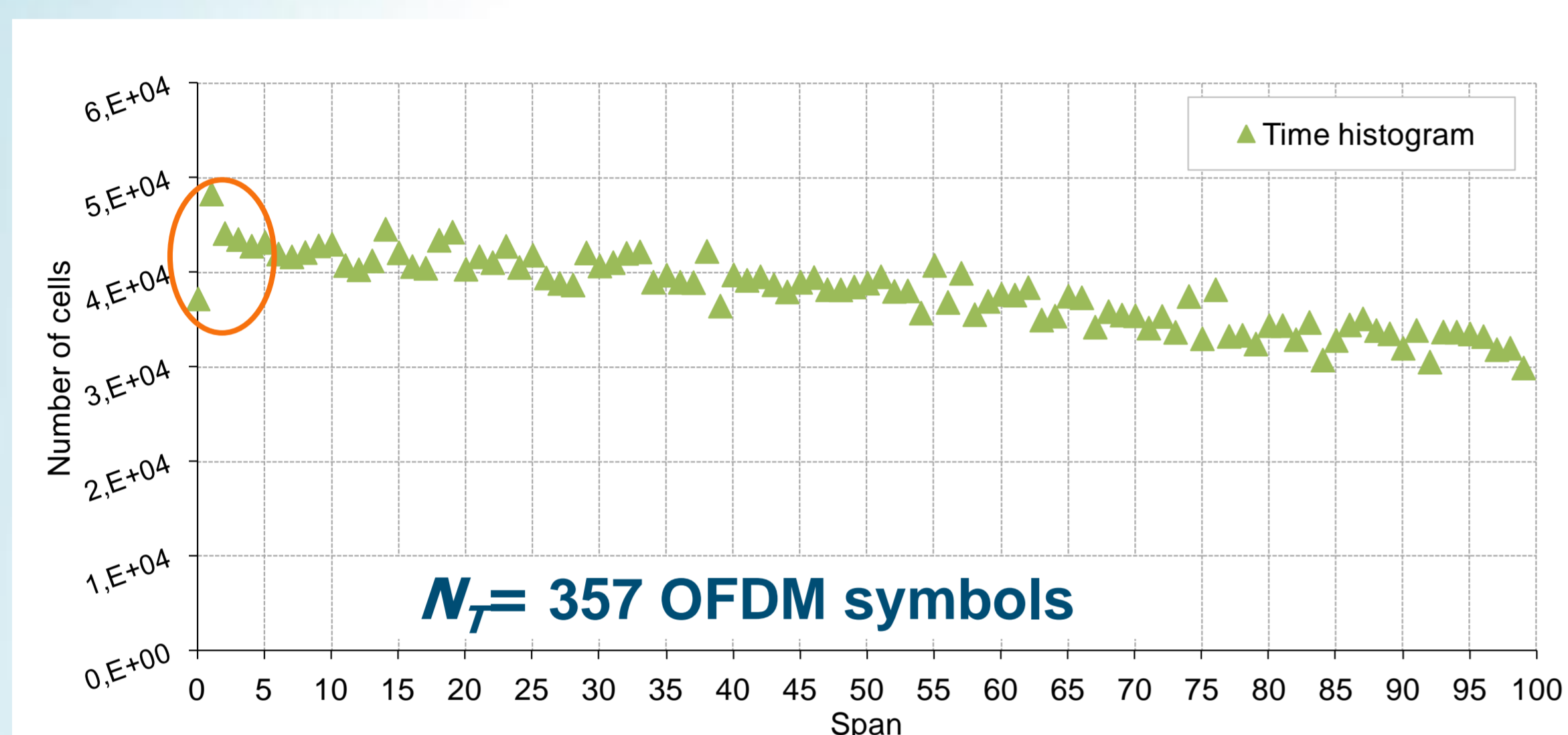
## Motivations

- In terrestrial broadcast standards such as DVB-T2, channel interleaving is achieved through stacking several specific interleavers => no global optimization is performed, bad interactions between the different interleavers sometimes occur
- Aim:** propose design criteria for channel interleavers based on span properties in the time and frequency domains and on the distribution of mutual information (MI)

## Span properties

- Frequency span:**  $S_f(i) = \min_j (|f_i - f_j| + |f_{\Pi(i)} - f_{\Pi(j)}|)$
- Time span:**  $S_t(i) = \min_j (|t_i - t_j| + |t_{\Pi(i)} - t_{\Pi(j)}|)$
- Design criterion:** maximize time and frequency spans

## Analysis of DVB-T2 interleaver



CI: Cell Interleaver TI: Time Interleaver, FI: frequency Interleaver

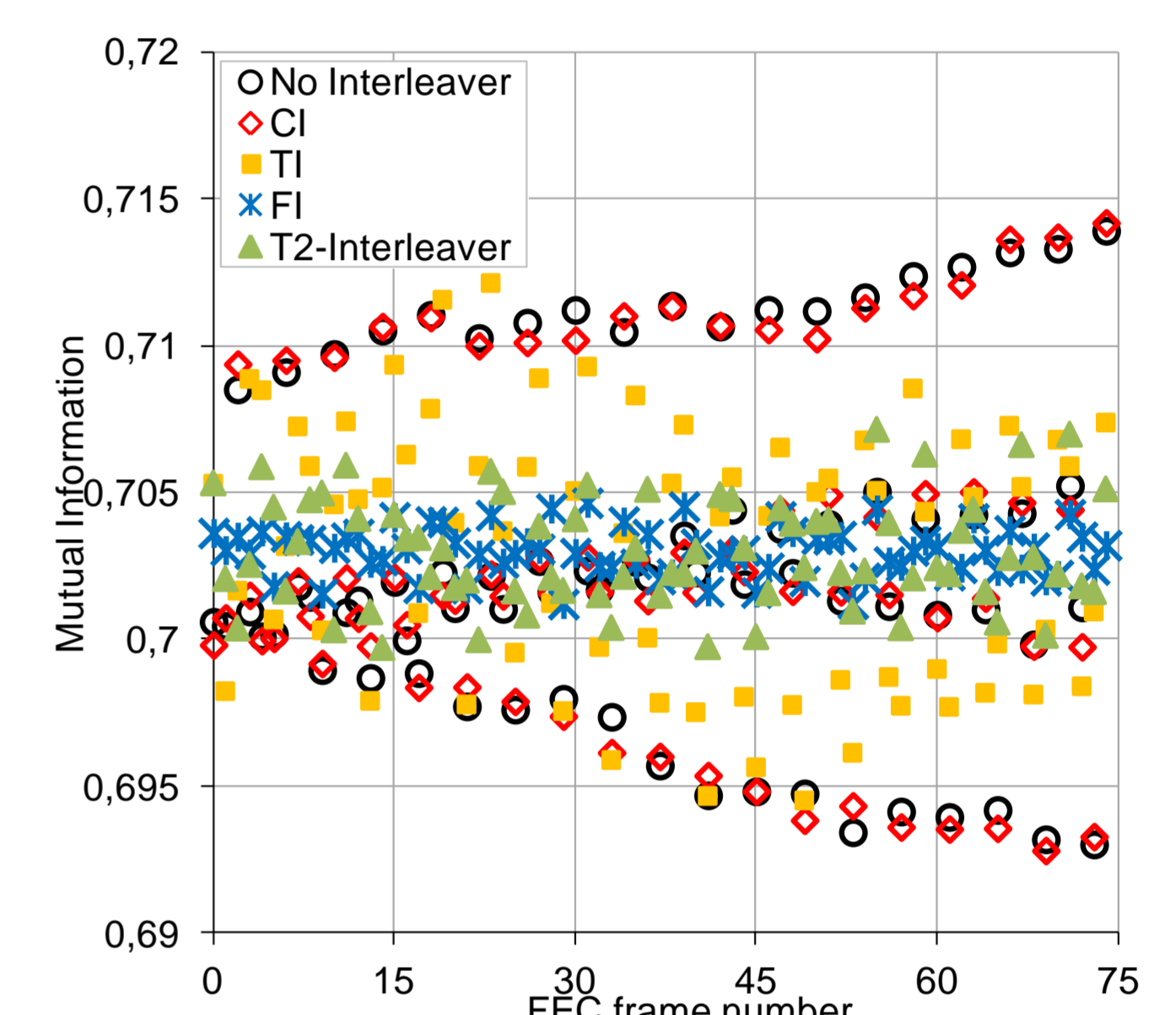
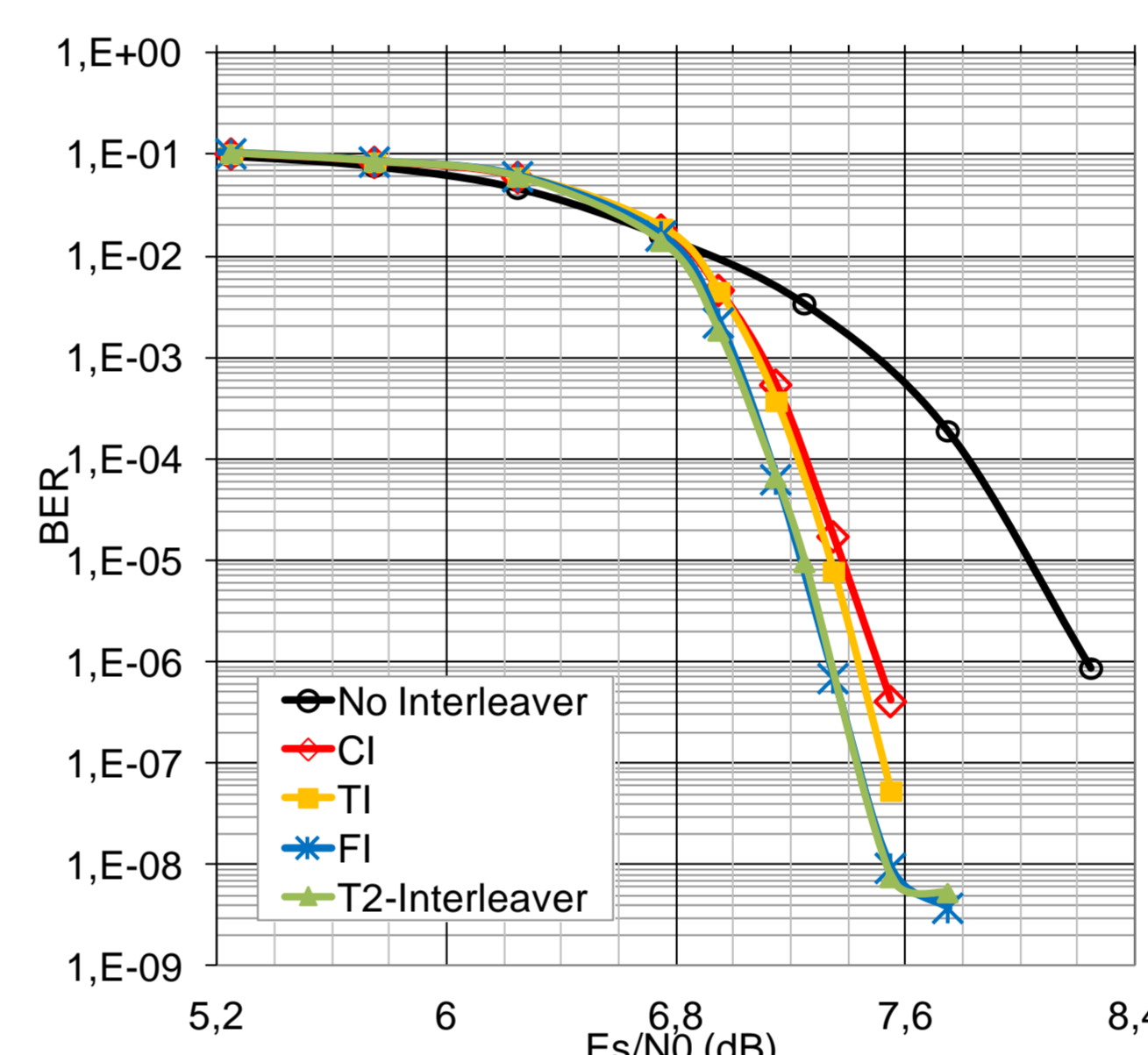
## Mutual information distribution

- Average mutual information (MI) per FEC block**

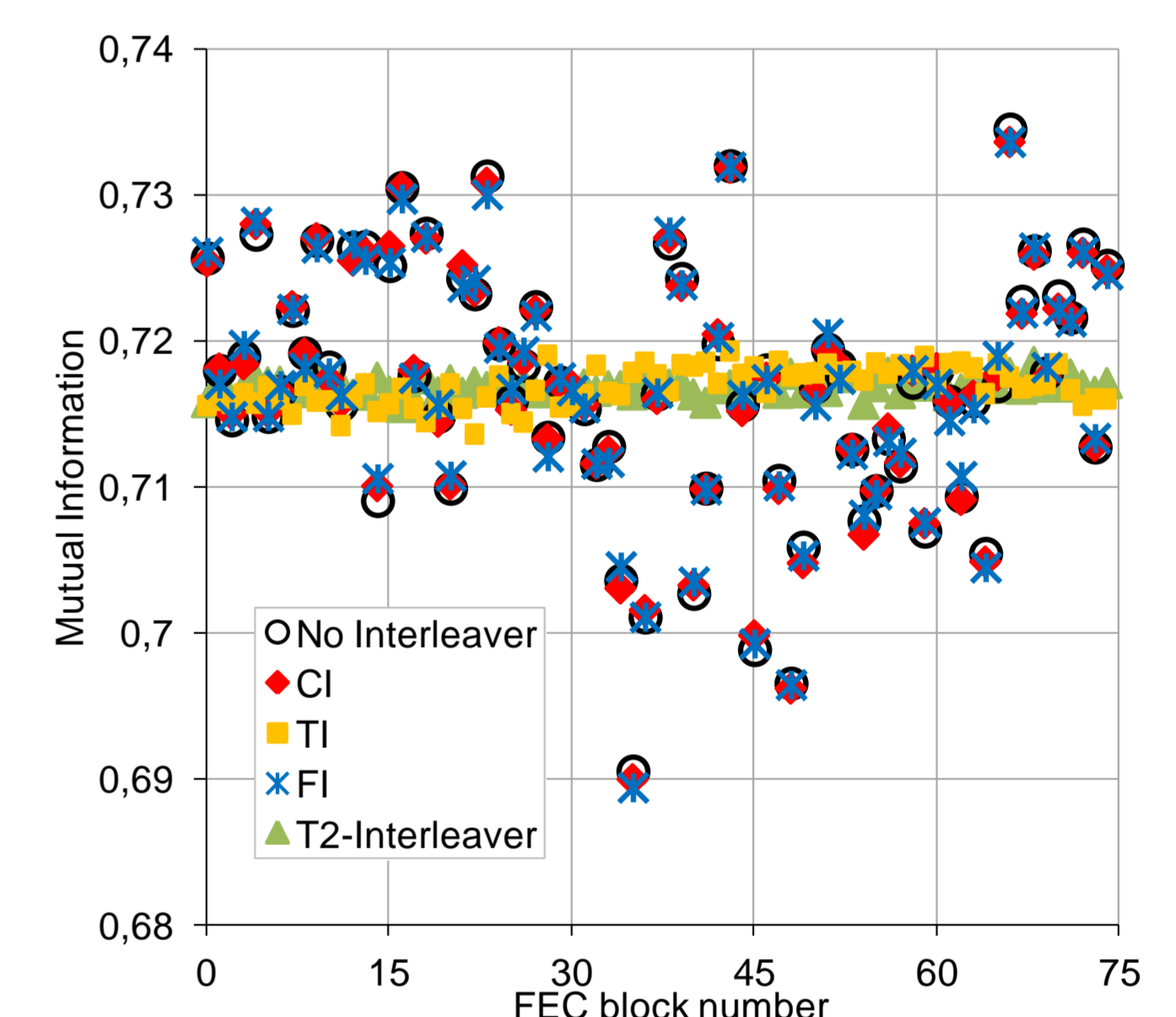
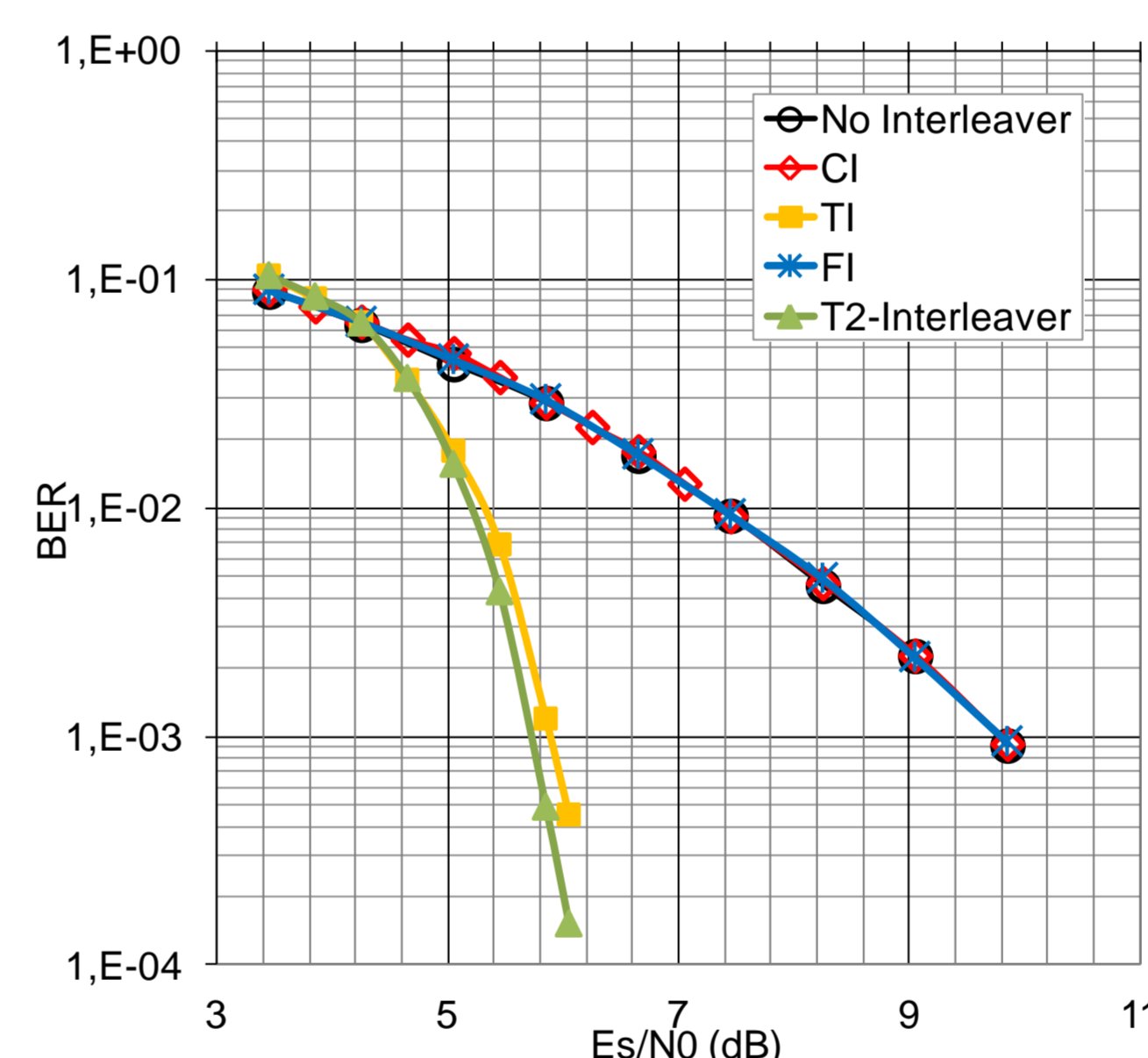
$$AMI_j = \log 2 - \sum_{i=1}^N [\max^*(0, z_i (-1)^{b_i})] / N$$

- Design criterion:** minimize the variance of MI distribution over FEC blocks in the OFDM frame => uniform distribution of the MI

P1 channel



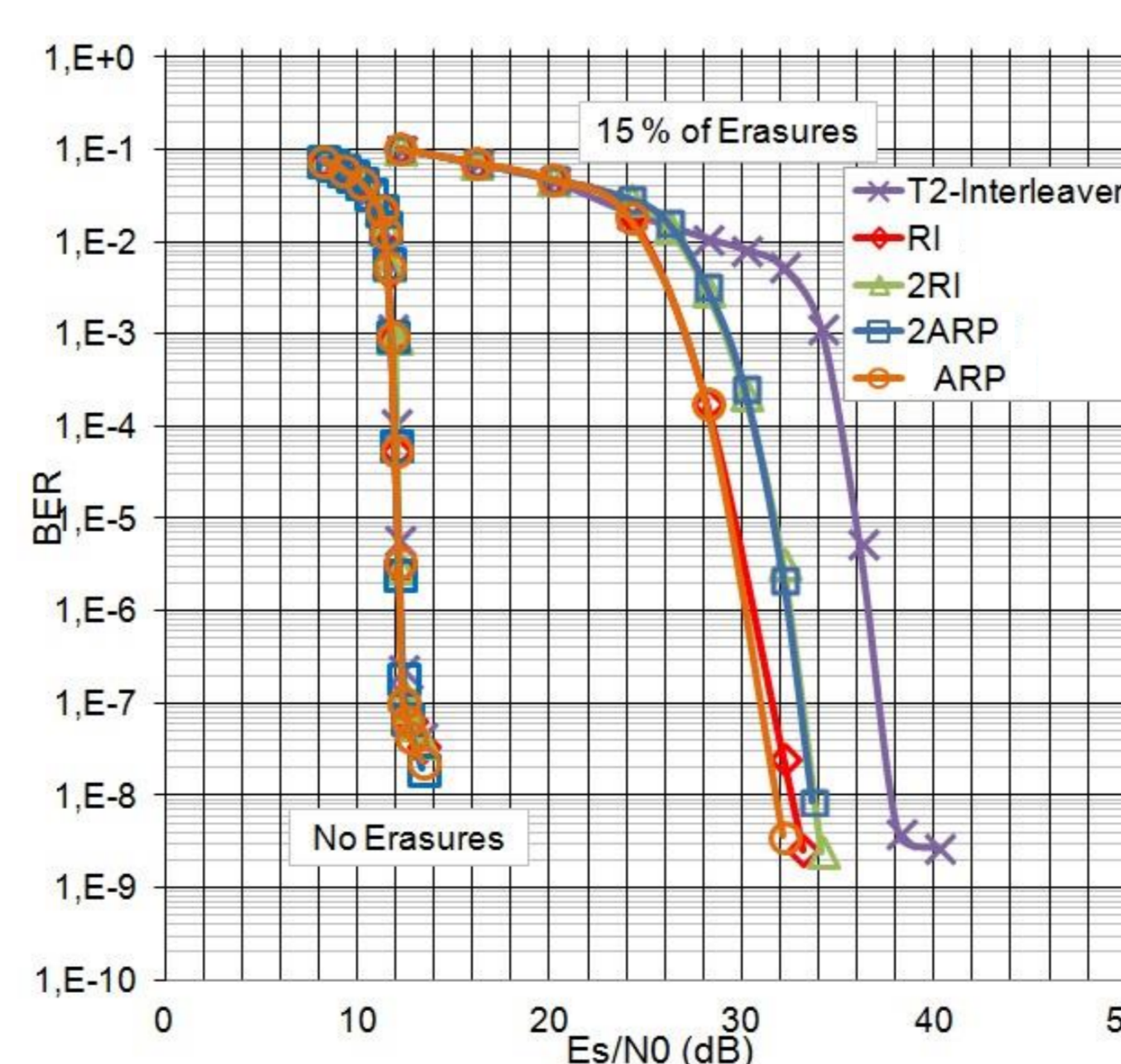
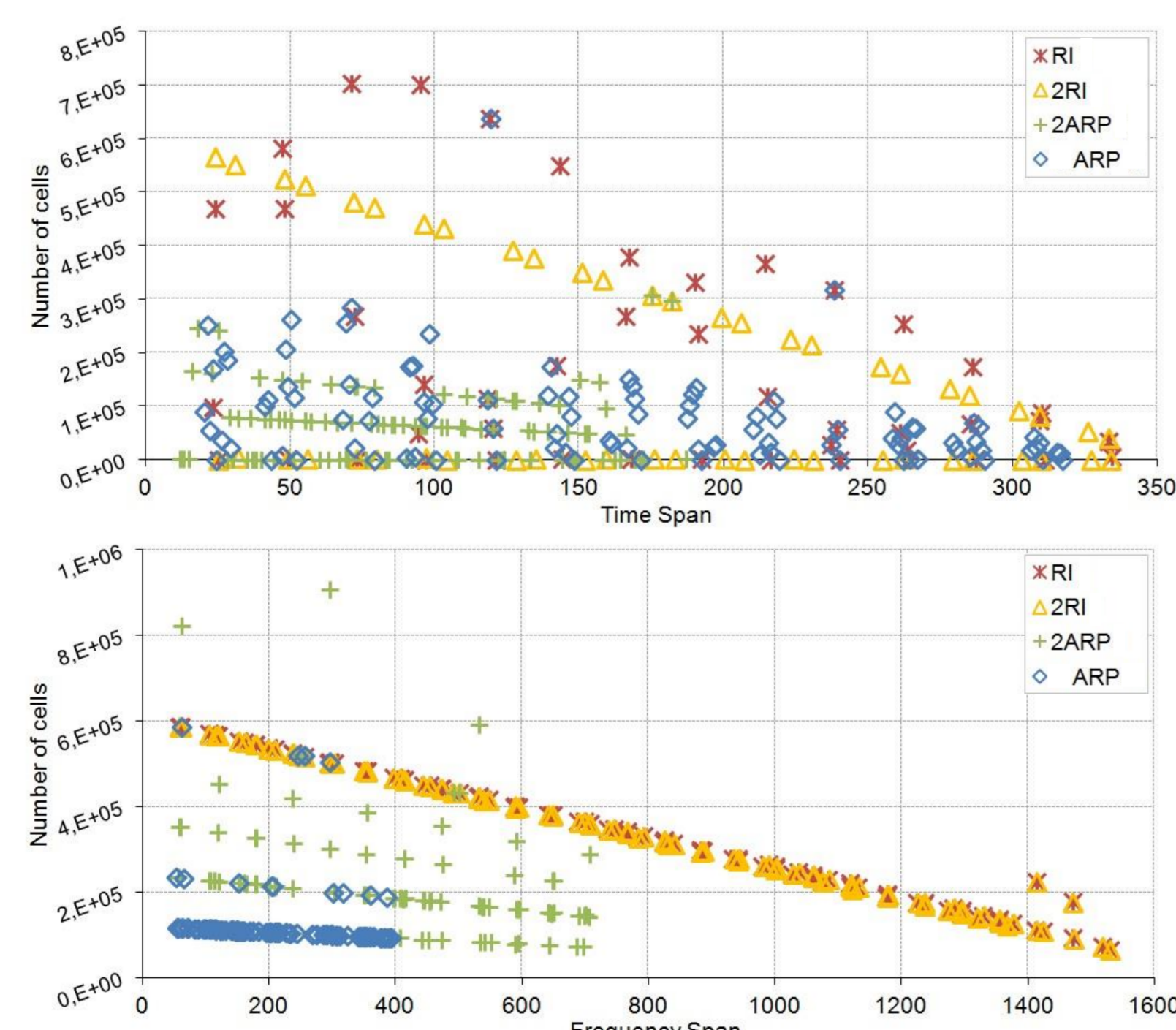
TU6 channel



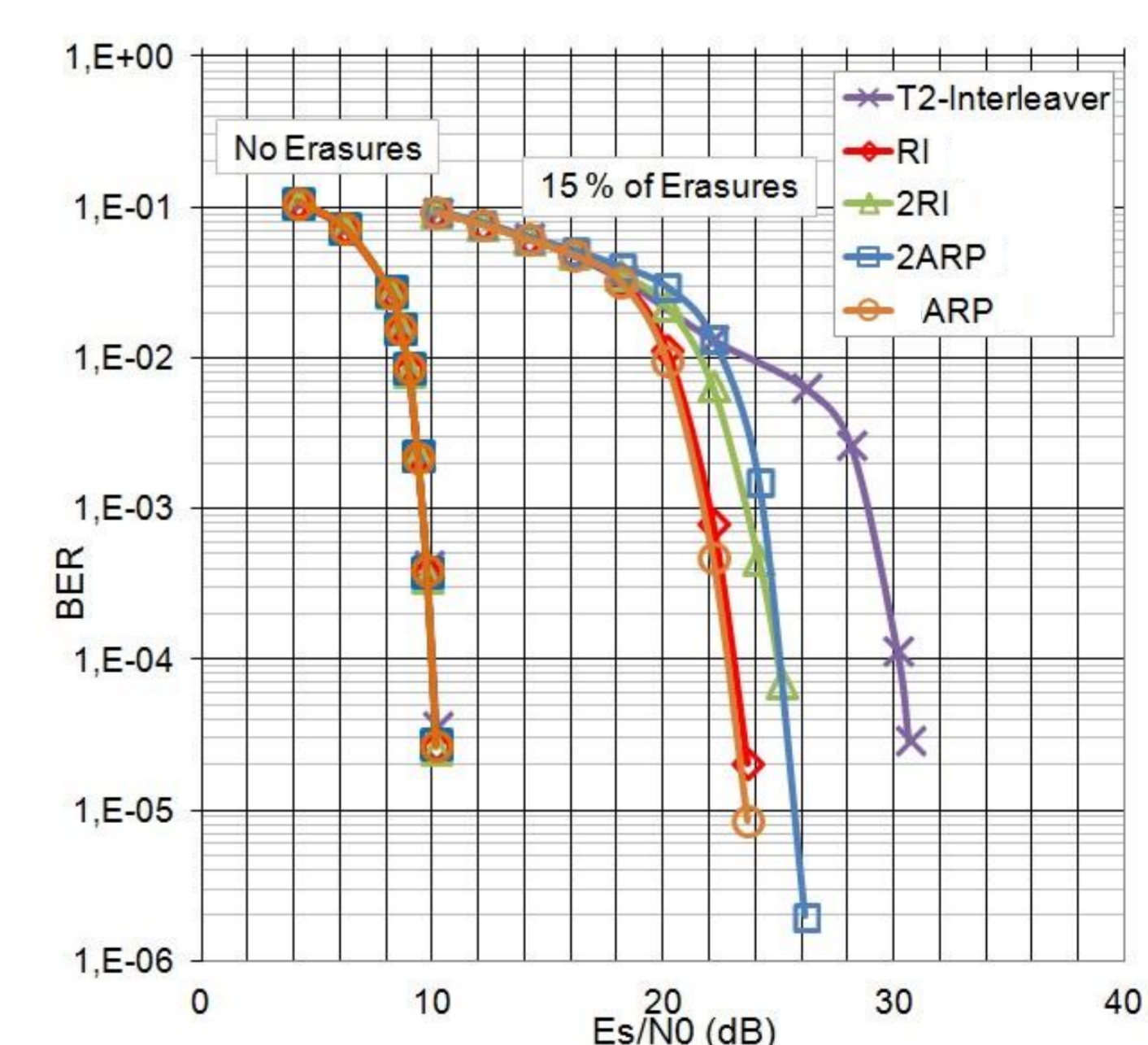
## Design of interleavers with good span and MI distribution properties

### Studied interleavers

- Regular interleaver (RI):**  $\Pi(i) = P \times i \bmod N_C$  with  $P = P_t \times N_F + P_f$ ,  $N_F$  being the number of cells in an OFDM frame
- Double regular interleaver (2RI):**  $\Pi(i) = N_F \times t_{\Pi(i)} + f_{\Pi(i)}$  with  $t_{\Pi(i)} = (P_t \times [i/N_F] + S_T \times i \bmod N_F) \bmod N_T$  and  $f_{\Pi(i)} = P_f \times i \bmod N_F$
- Almost regular permutation (ARP):** same as RI with cyclic shift in  $\Pi(i)$  expression
- Double almost regular permutation (2ARP):** same as 2RI with cyclic shifts in  $t_{\Pi(i)}$  and  $f_{\Pi(i)}$  expressions



P1 channel, LDPC code rate 37/45



TU6 channel, LDPC code rate 37/45