

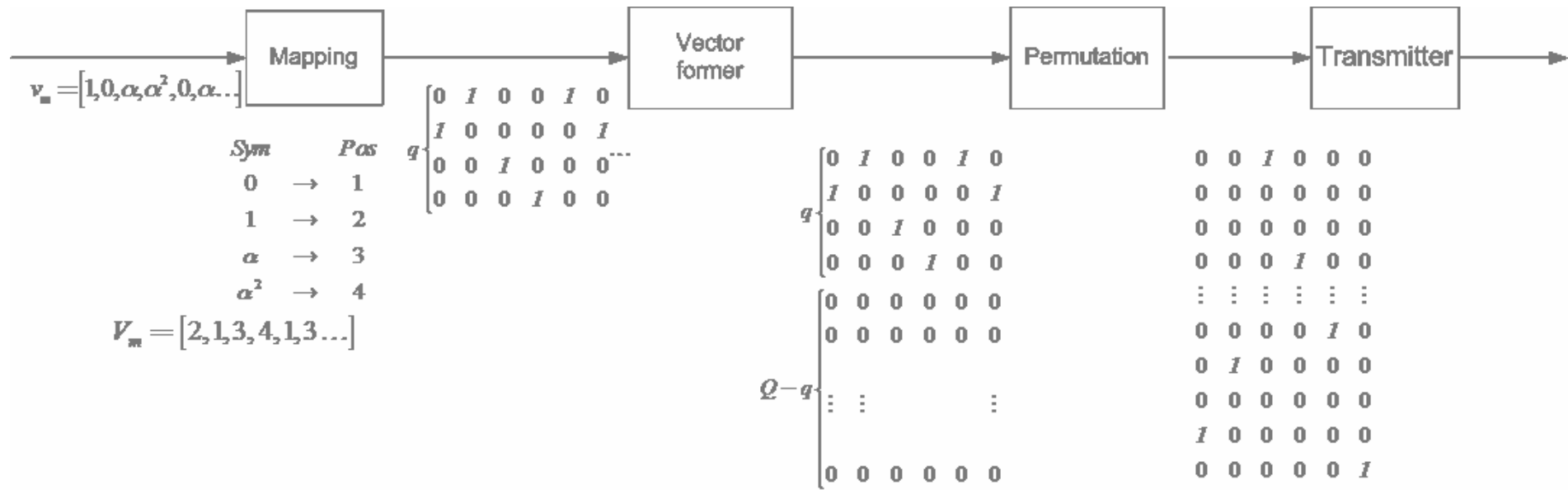
Obtaining reliability values from
nonparametric receiver: the “optimal”
parameter choice

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Coded transmission

- ▶ Bijective mapping (Kautz-Singleton construction)
- ▶ Appending zero-matrix
- ▶ Column-wise permutation



Detection problem

- ▶ Detection problem:

Given: a $q \times n$ matrix of decision statistics

Problem: to find elements corresponding to the transmitted codeword

Solution sketch: two stages

- ▶ Decision matrix computation
- ▶ Decoding

Decision matrix is essentially a matrix of reliabilities



Decoding

Decision matrix

D ₁₁	D ₁₂	D ₁₃	D ₁₄	D ₁₅	D ₁₆
D ₂₁	D ₂₂	D ₂₃	D ₂₄	D ₂₅	D ₂₆
D ₃₁	D ₃₂	D ₃₃	D ₃₄	D ₃₅	D ₃₆
D ₄₁	D ₄₂	D ₄₃	D ₄₄	D ₄₅	D ₄₆



i th codeword

$$V_i = [0, 2, 0, 3, 1, 3]$$



j th codeword

$$V_j = [1, 2, 3, 1, 1, 0]$$

$$S_i = D_{11} + D_{32} + D_{13} + D_{44} + D_{25} + D_{46}$$

$$S_j = D_{21} + D_{32} + D_{43} + D_{24} + D_{25} + D_{16}$$

$$m^* = \arg \max_m S_m$$



RANK detector

Possible solution: RANK detector (Kondrashov K.& Afanassiev V.(ACCT 2012)

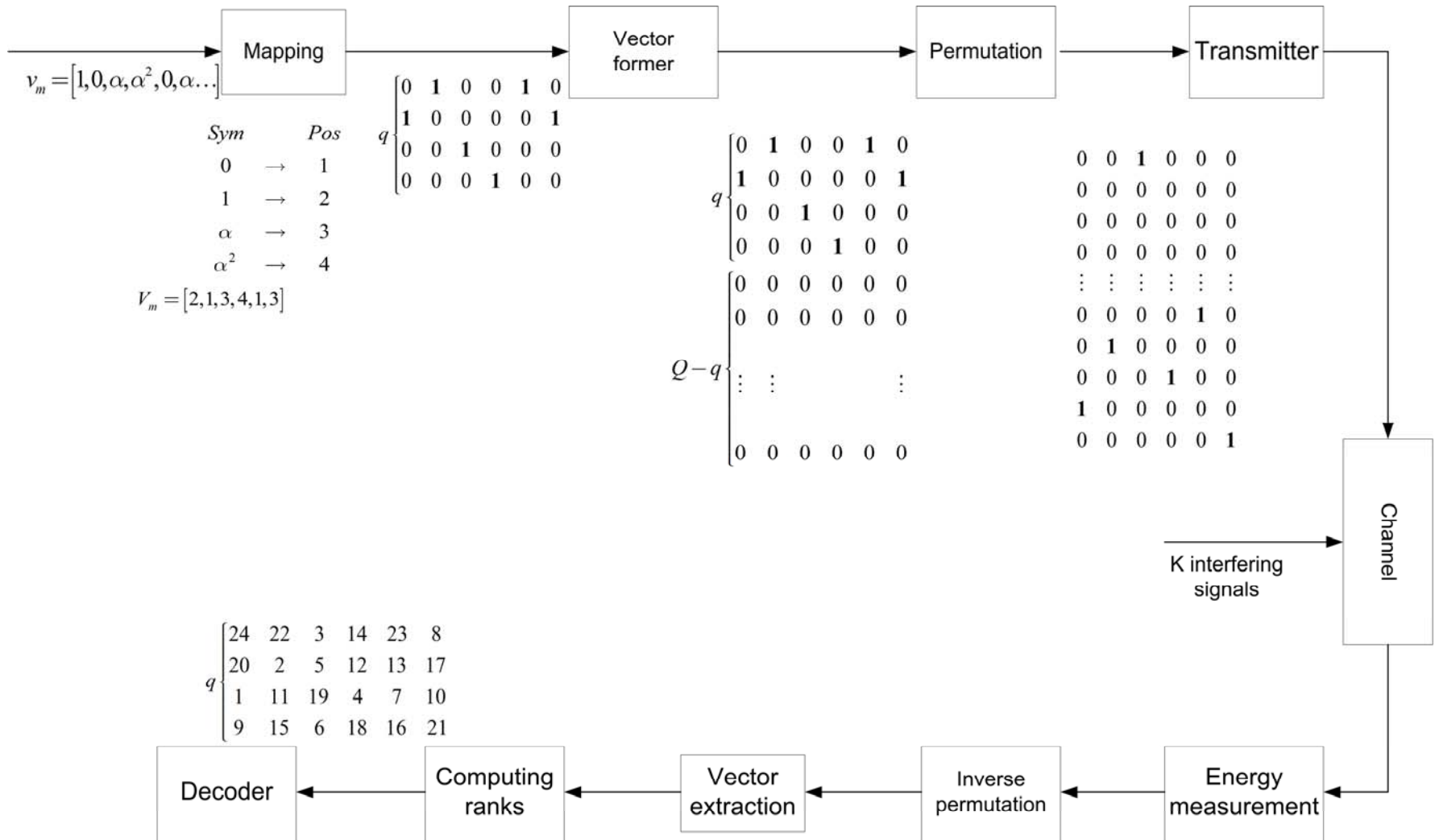
Each element is replaced with its **rank** i.e. the number of elements less than this element

Codeword corresponding to the greatest rank-sum is to be chosen

Similar (in some sense) to Wilcoxon test, Mann–Whitney test ect.



Communication system (with α detector)



α detector

RANK detector

- ▶ Requires sorting of an $q \times n$ matrix
- ▶ Thus complexity is $O(M \log(M))$ where $M = q \cdot n$
- ▶ delay is proportional to n

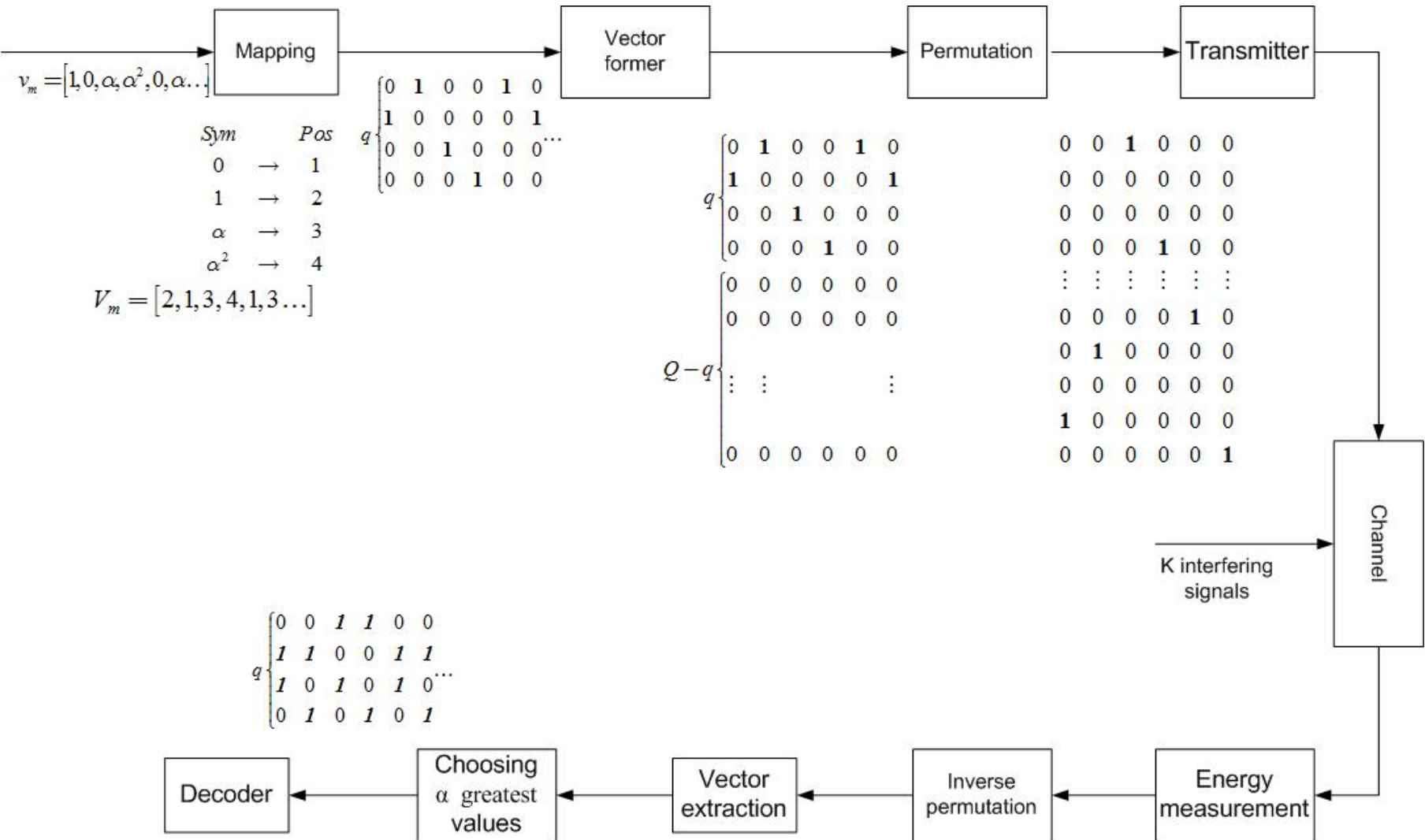
α detector (Osipov, 2014)

Choose α greatest values in each column and assign “1” to the greatest ones and “0” to the remainder elements of the column

- lower delay
 - lower complexity
 - can be treated analytically
-



System model (with RANK detector)



Simulation parameters

- ▶ K “narrowband” interfering signals

(each having a power $\kappa=10^4$ times greater than that of the user under consideration)

- ▶ Broadband noise characterized by the signal-to-noise ratio given by

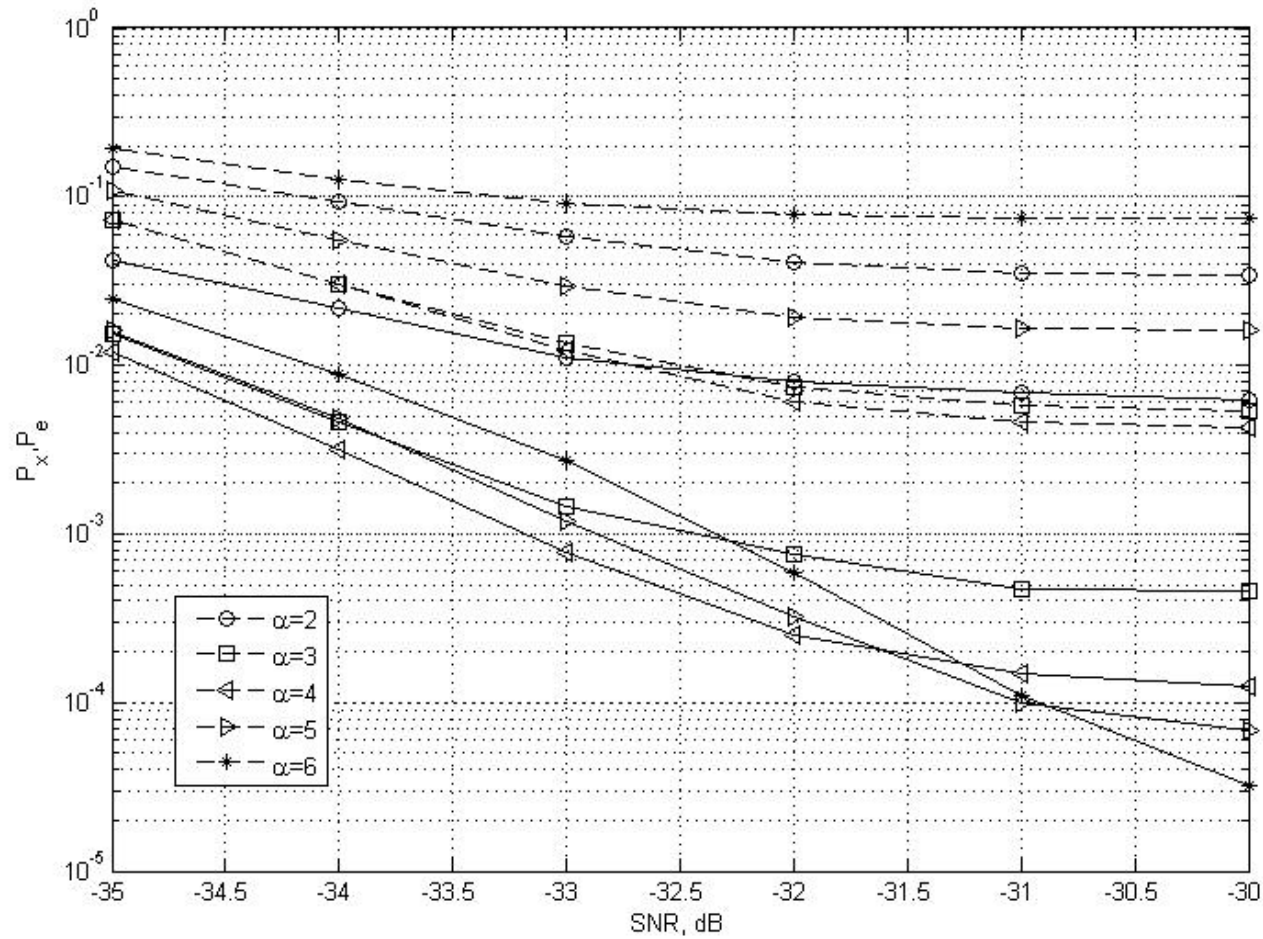
$$SNR = 10 * \log_{10} \left(\frac{E_s}{E_N} \right)$$

where E_N is noise energy in the entire band whereas E_s is the energy in the effective band occupied by the transmitted signal

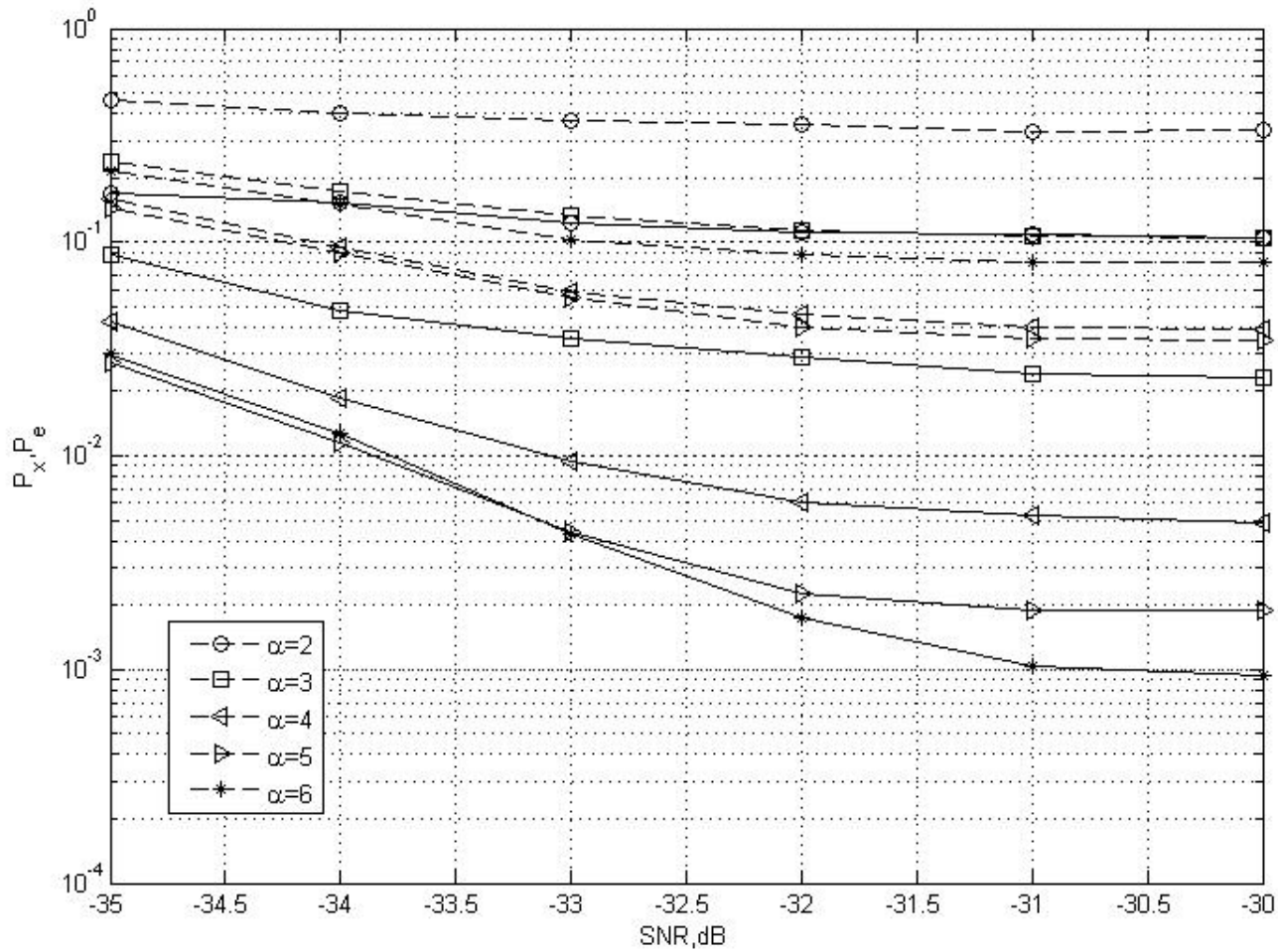
Total number of available channels $Q=4096$



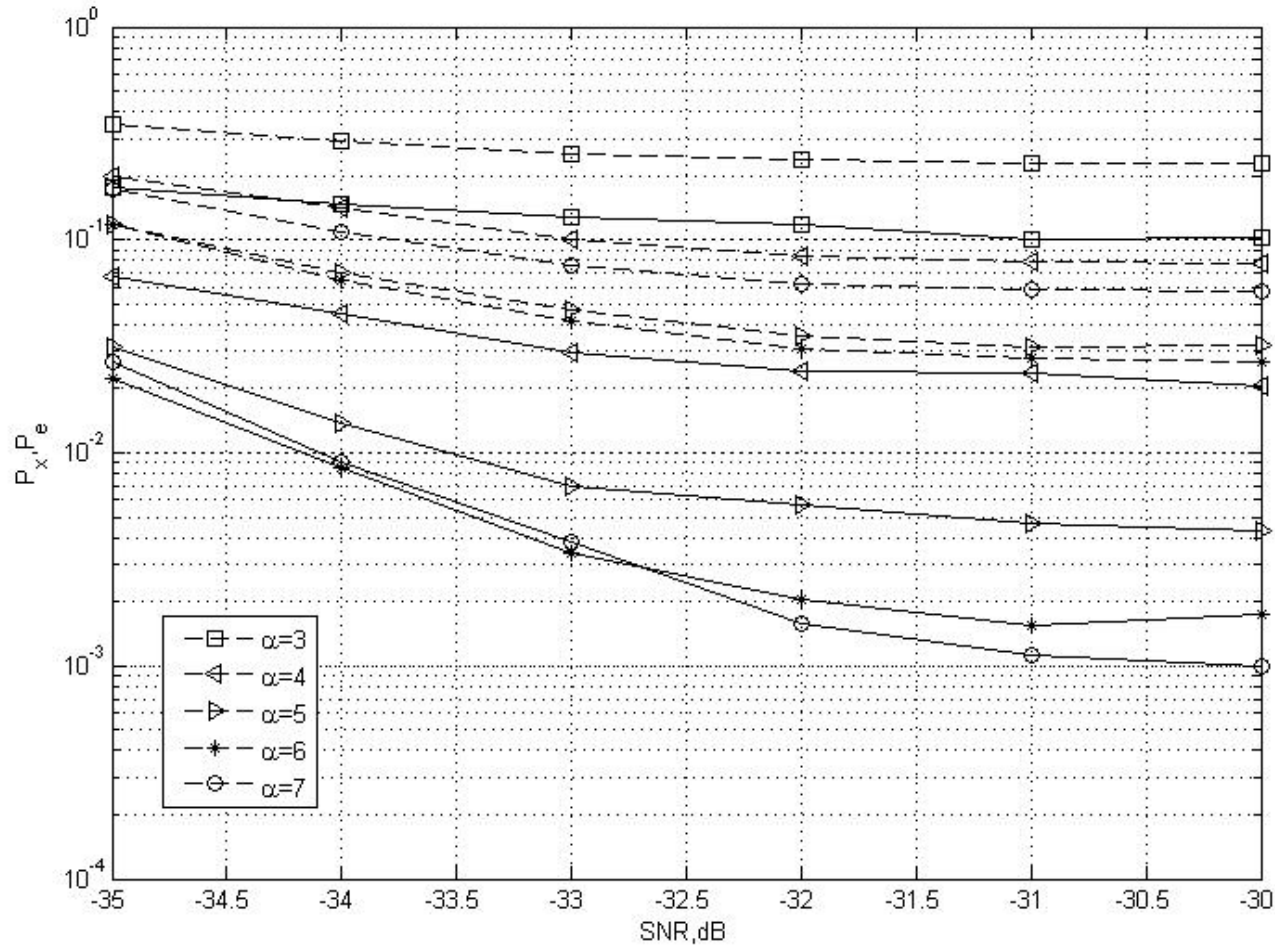
Simulation results($K=200, R=1/4, q=16$)



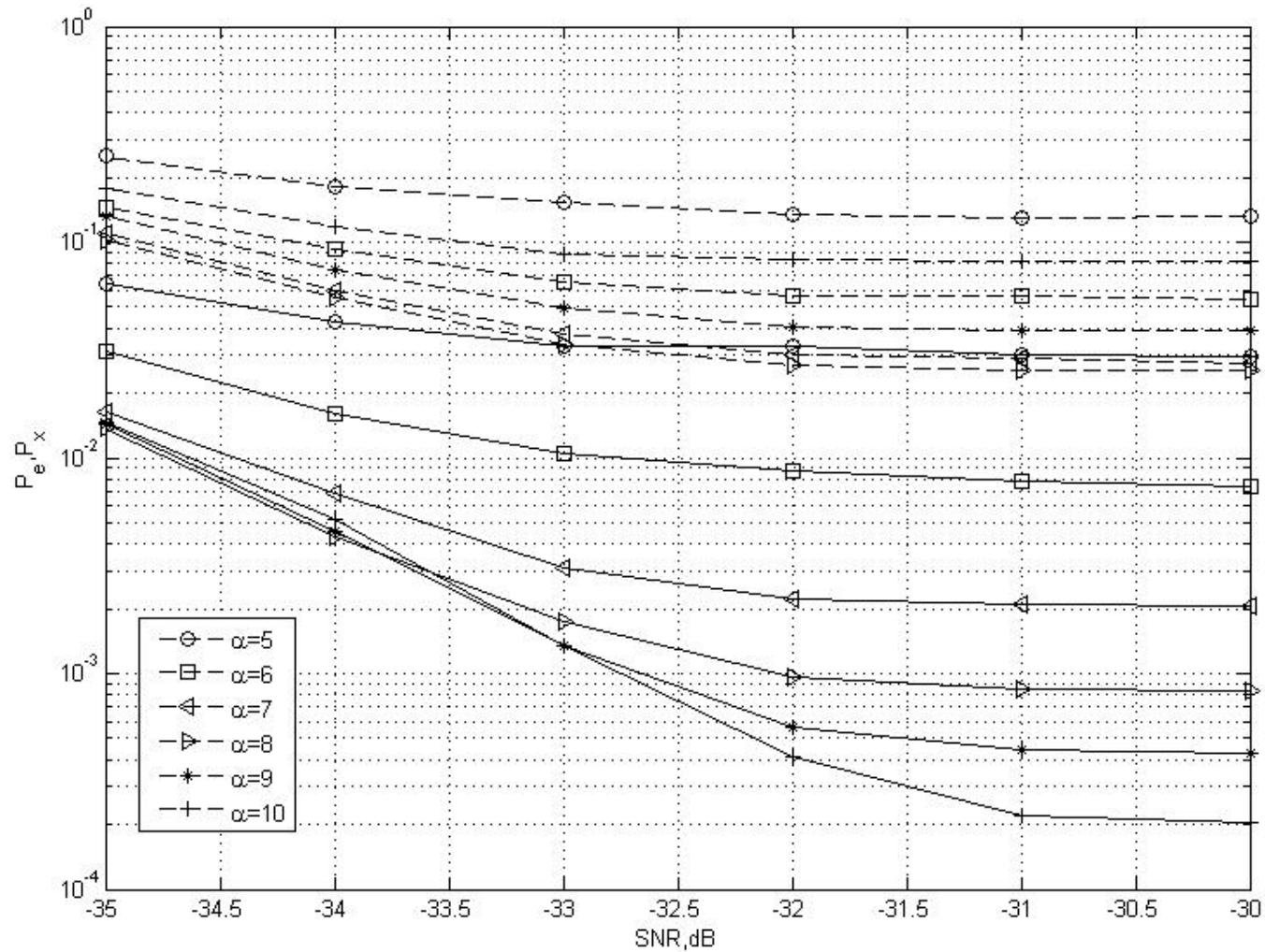
Simulation results ($K=400, R=1/4, q=16$)



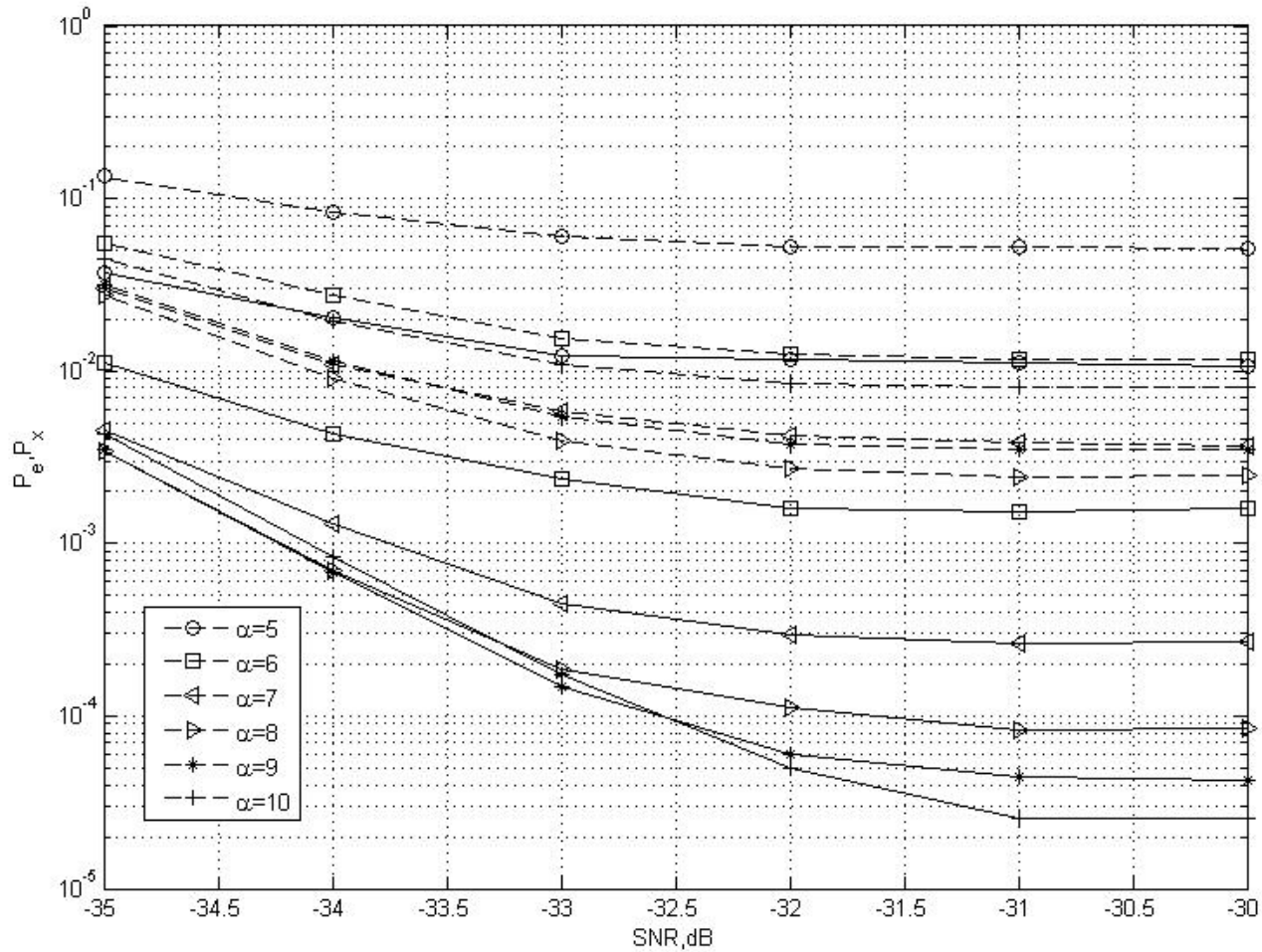
Simulation results ($K=600, R=1/5, q=16$)



Simulation results($K=400, R=1/4, q=32$)



Simulation results($K=400, R=1/5, q=32$)



Thank you for your attention!