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Maximum Ratio Transmission and Zero-Forcing Preprocessing for Extended Receive Antenna Shift Keying (ERASK) and RASK transmission

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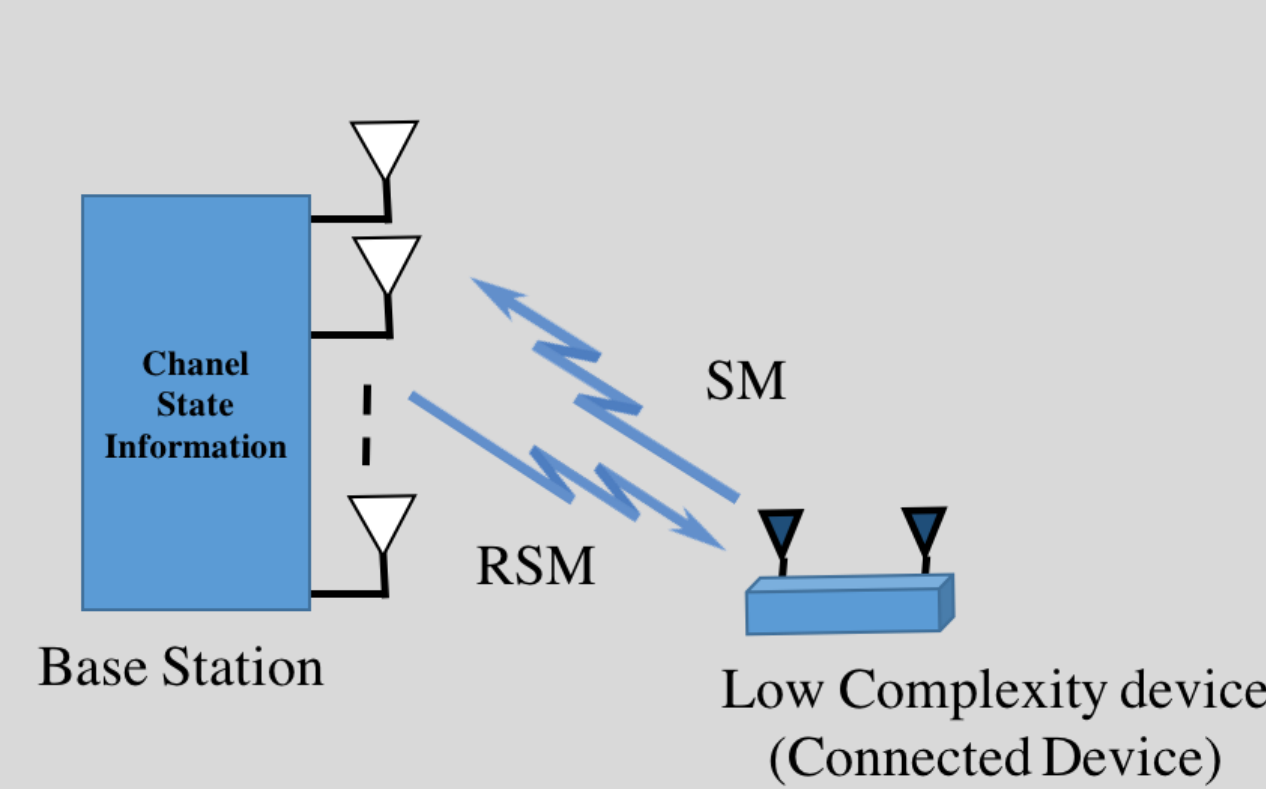
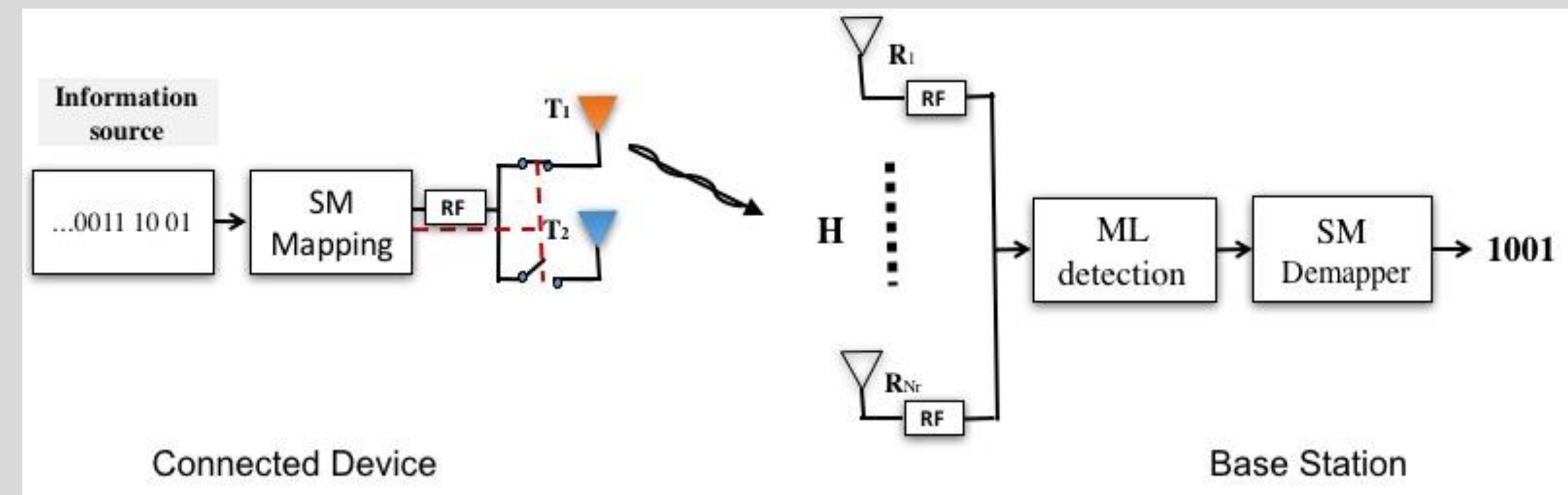
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1-Context

Propose an up-link and down-link transmission scheme for low complexity and low power consumption devices.

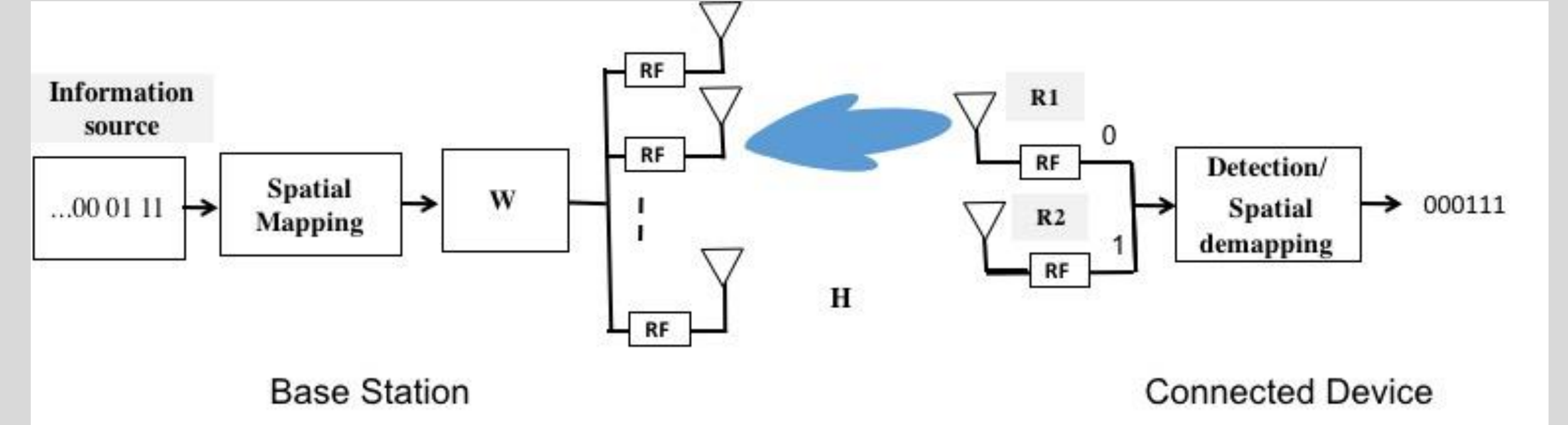
Transmit Spatial Modulation :

- Index of activated antenna carries additional information
- Bit to antenna mapping (index modulation)



Receive Spatial Modulation:

- Index of targeted antenna carries the information
- A preprocessing matrix is used to target receive antennas



2-Receive Antenna Shift Keying

1- Receive Antenna Shift Keying:

000 010 101 011	Symbol 1	Symbol 2	Symbol 3	Symbol 4
1) Segmentation	000	010	101	011
2) Mapping	R1	R3	R6	R4
3) Preprocessing (focalisation)				
4) Detection	R1	R2	R3	R4
5) Demapping	00	01	11	10

- One targeted antenna at each symbol duration
- Spectral efficiency: $\eta = \log_2(N_R)$.
- Spatial symbol: $\mathbf{X} = [0 \dots x_k \dots 0]^T$ where k is the position of the targeted antenna.

2- Extended Receive Antenna Shift Keying:

101 110 010 011	Symbol 1	Symbol 2	Symbol 3	Symbol 4
1) Segmentation	101	110	010	011
2) Mapping	R1&R3	R1&R2	R2	R2&R3
3) Preprocessing (focalisation)				
4) Detection	R1&R3	R1&R2	R2	R2&R3
5) Demapping	101	110	010	011

- Variable number of targeted antennas at each symbol duration
- Spectral efficiency: $\eta = N_R$.
- Spatial symbol: $\mathbf{X} = [x_1 x_2 \dots x_{N_r}]^T$ where $x_i \in \{0, A\}$

- The equation of transmitted signal is : $\mathbf{S} = f \mathbf{W} \mathbf{X}$
- W: preprocessing matrix
- f: normalization factor

4-Detection

For RASK scheme:

- One receive antenna (RA) is targeted
- The receiver detect the index of antenna that receives maximum amplitude.

For ERASK scheme:

All RAs could be targeted or not.

- Using ZF, no inter-antenna interference, a simple threshold could be used on each RA
- Using MRT, the interference is added to the signal. We use a detector of threshold between the maximum and the minimum received amplitude.

3-Preprocessing

A channel State Information is needed at the transmitter.

Two techniques are used :

Maximum Ratio Transmission:

- Enables to focus signal toward the targeted antenna.
- The trans-conjugate of the propagation channel impulse response is used as pre-filtre:

$$\mathbf{W} = \mathbf{H}^H$$

- The equation of the received signal is: $\mathbf{Y} = f \mathbf{H} \mathbf{H}^H \mathbf{X} + \mathbf{N}$

Zero- Forcing:

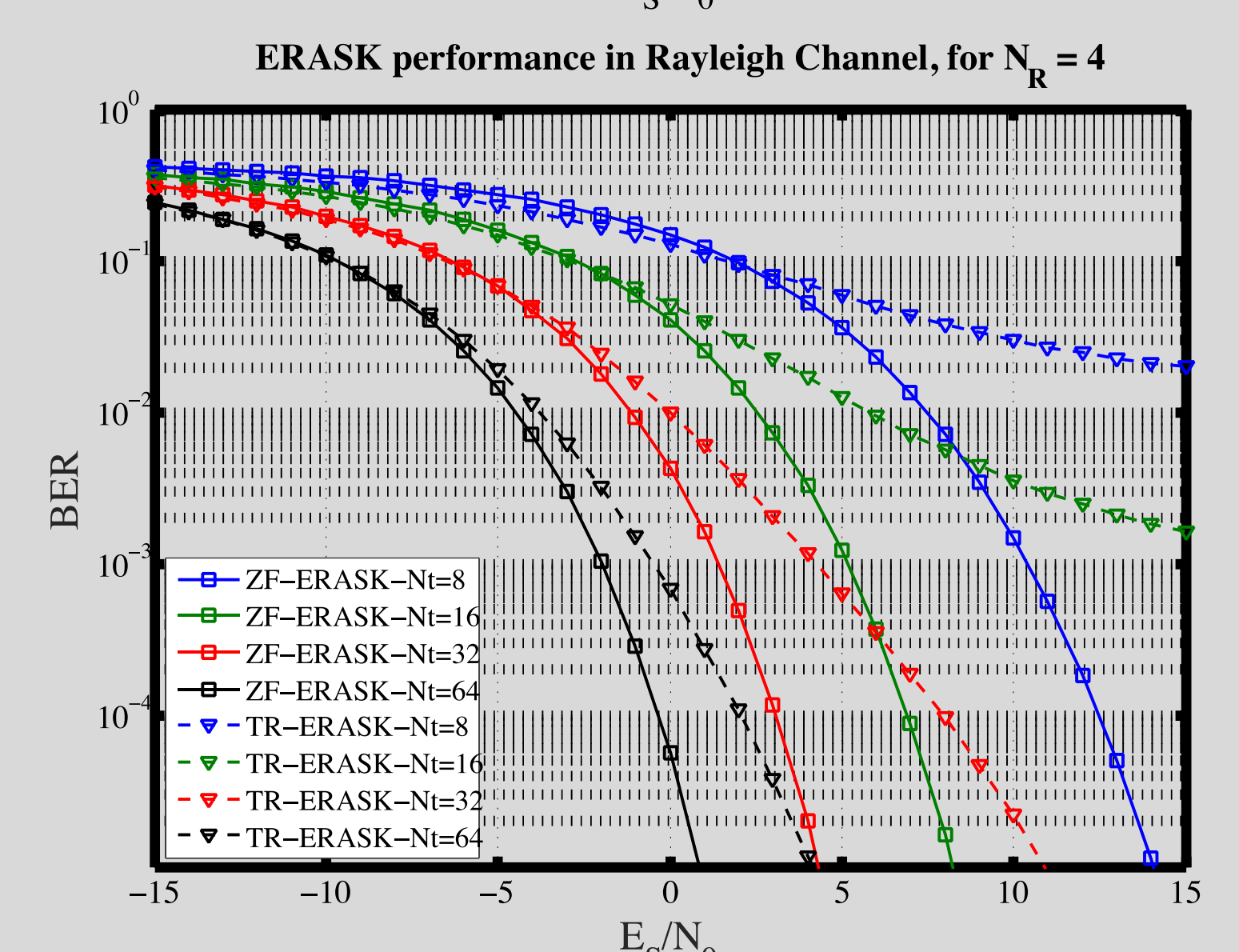
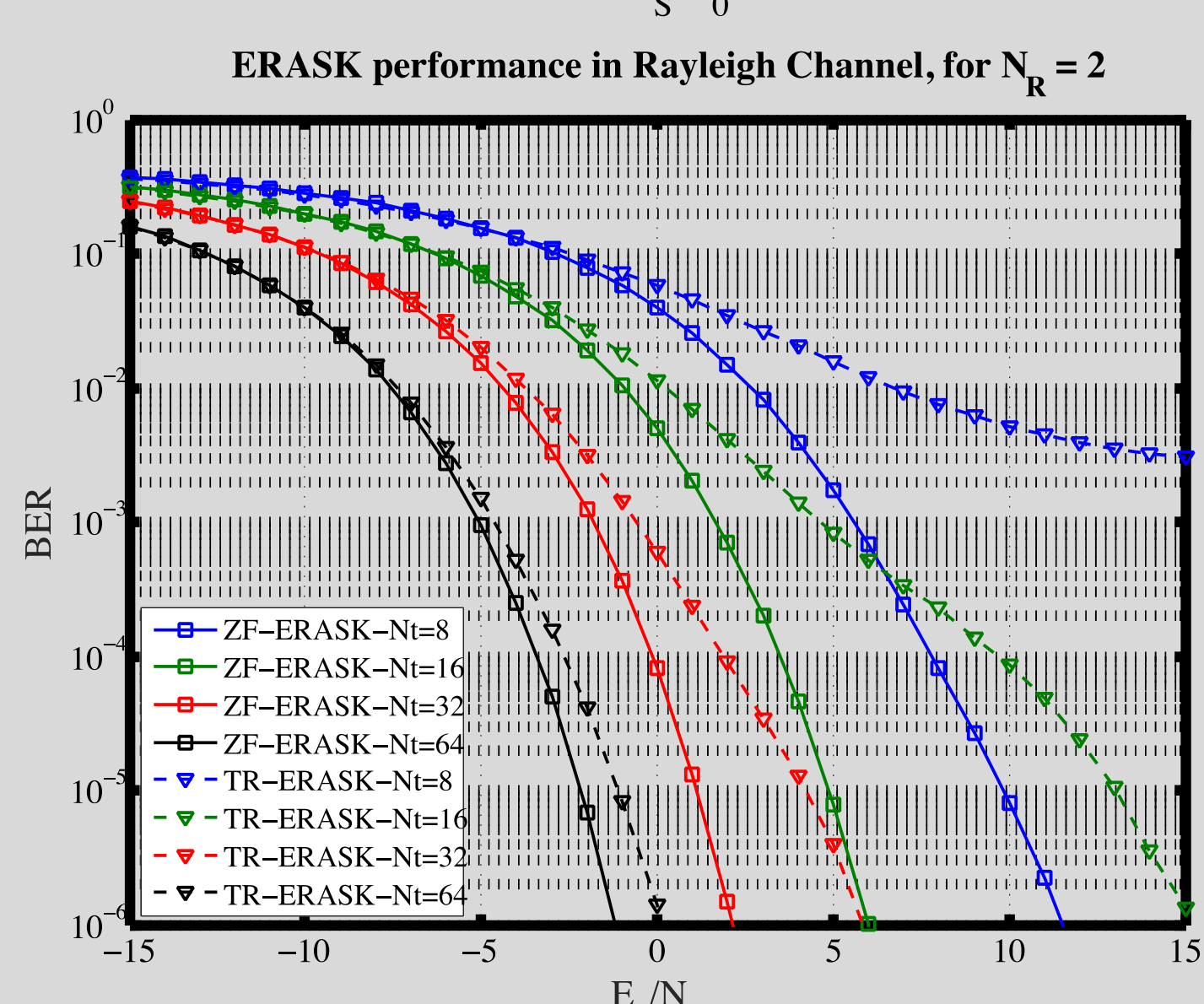
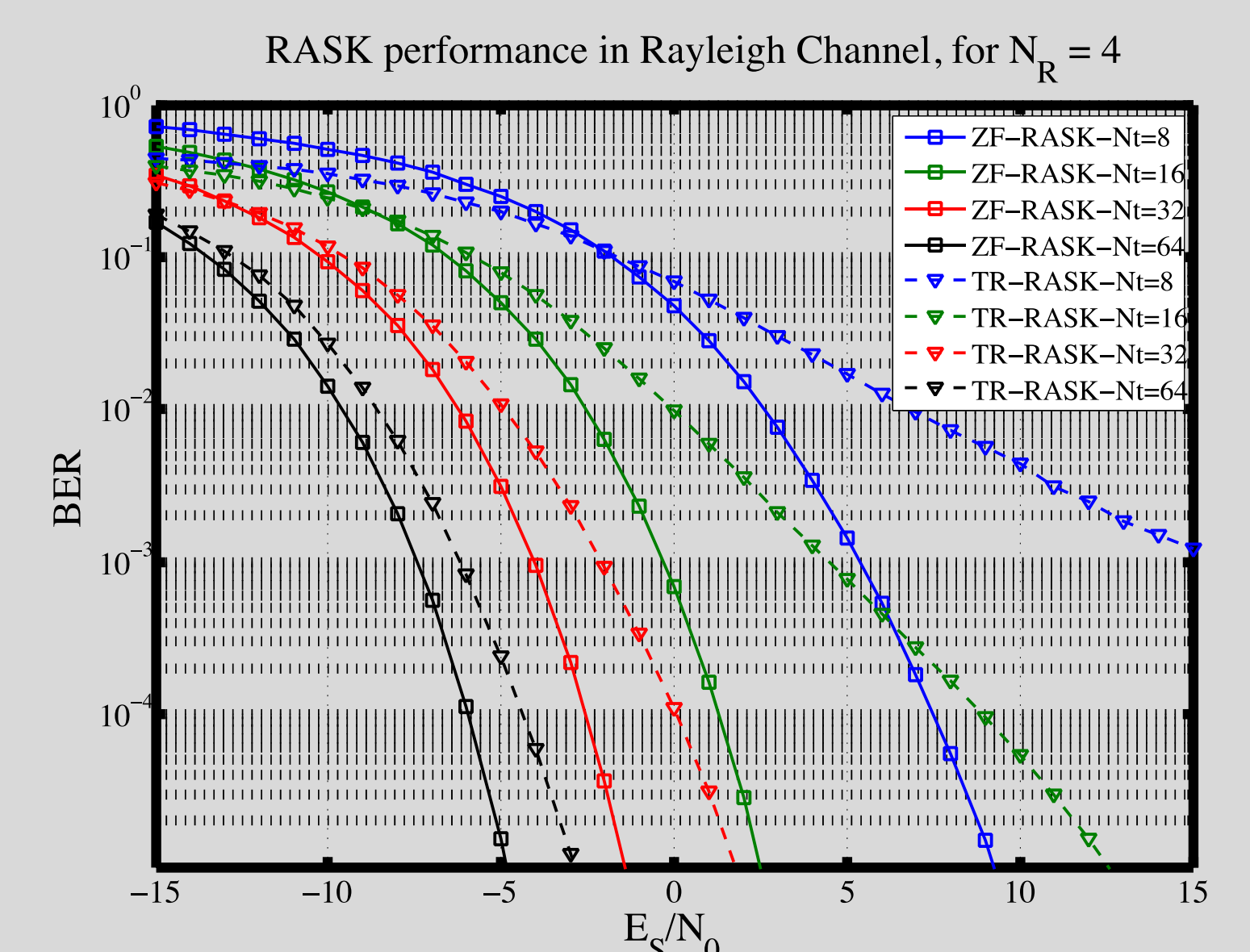
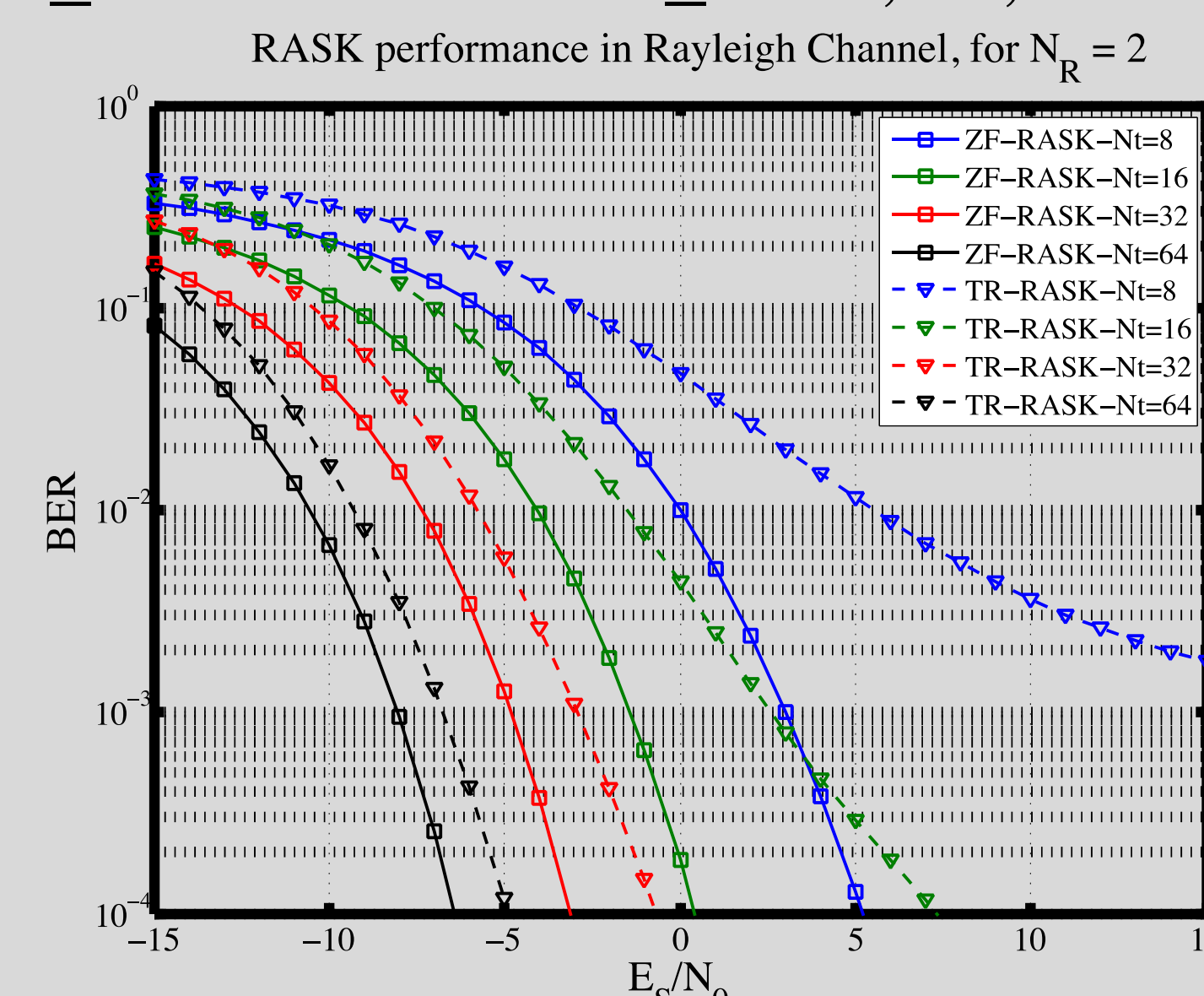
- Used to annihilate the signal over the non targeted antennas
- The pseudo inverse of the propagation channel impulse response is used as pre-filtre:

$$\mathbf{W} = \mathbf{H}^H (\mathbf{H} \mathbf{H}^H)^{-1}$$

- The equation of the received signal is: $\mathbf{Y} = f \mathbf{X} + \mathbf{N}$

5-Simulation

A MIMO Channel with Rayleigh fading
 $N_R = 2$ and 4 and $N_T = 8, 16, 32$ and 64



For low complexity receivers, ZF preprocessing outperforms MRT
Interference cancellation detectors could be used for better performance with higher cost of complexity

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