

# HARQ in a Closed Loop MIMO System

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[ ]

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Adoption of the proposed text into SDD

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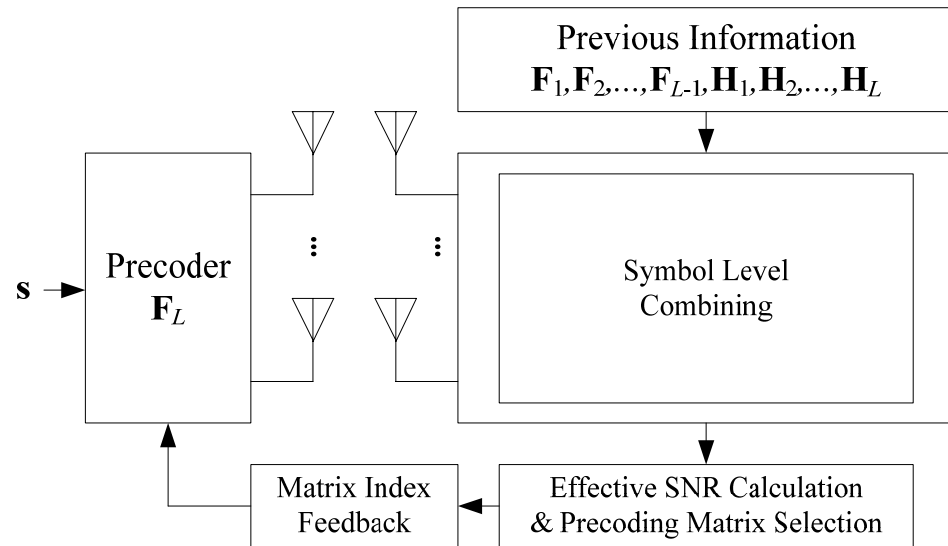
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# HARQ in a Closed-loop MIMO System (1)

- Overall System Model



- Received signal for the  $l$ -th transmission,

$$\mathbf{r}_l = \mathbf{H}_l \mathbf{F}_l \mathbf{s} + \mathbf{w}_l = \tilde{\mathbf{H}}_l \mathbf{s} + \mathbf{w}_l \quad \text{where } \mathbf{H}_l : \text{Channel Matrix for the } l\text{-th transmission}$$

- Integrated signal with concatenated combining

$$\mathbf{r} = \begin{bmatrix} \mathbf{r}_1 \\ \mathbf{r}_2 \\ \vdots \\ \mathbf{r}_L \end{bmatrix} = \begin{bmatrix} \mathbf{H}_1 \mathbf{F}_1 \\ \mathbf{H}_2 \mathbf{F}_2 \\ \vdots \\ \mathbf{H}_L \mathbf{F}_L \end{bmatrix} \mathbf{s} + \begin{bmatrix} \mathbf{w}_1 \\ \mathbf{w}_2 \\ \vdots \\ \mathbf{w}_L \end{bmatrix}$$

# HARQ in a Closed-loop MIMO System (2)

- **Basic Operation**

- To use the different pre-coding matrix (selected from a codebook) in the course of retransmission, so as to fully utilizing the multiple receptions of MIMO signals subject to the given type of retransmission combining.

- **Design Consideration**

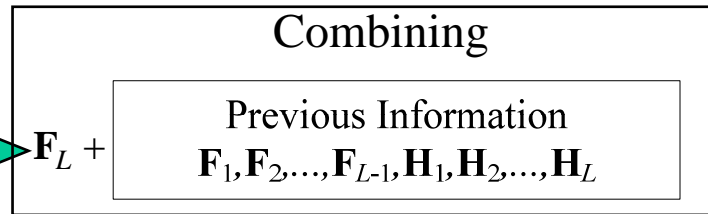
- To design the pre-coding matrix selection criterion
- To design the pre-coding matrix to be suited to the HARQ in a closed-loop MIMO

# Precoding Matrix Selection Procedure

- Example: Effective SNR-based Criterion

**STEP 1:**

For each matrix in codebook



**STEP 2:**

Post-Detection SNR Calculation after Combining

$$\gamma_i = \frac{|\mathbf{g}_i \tilde{\mathbf{h}}_i|^2 \sigma_s^2}{\sum_{j \neq i}^{N_T} |\mathbf{g}_j \tilde{\mathbf{h}}_i|^2 \sigma_s^2 + \|\mathbf{g}_i\|^2 \sigma_w^2}$$

**STEP 3:**

Effective SNR Calculation after Combining

MIESM, EESM, etc.

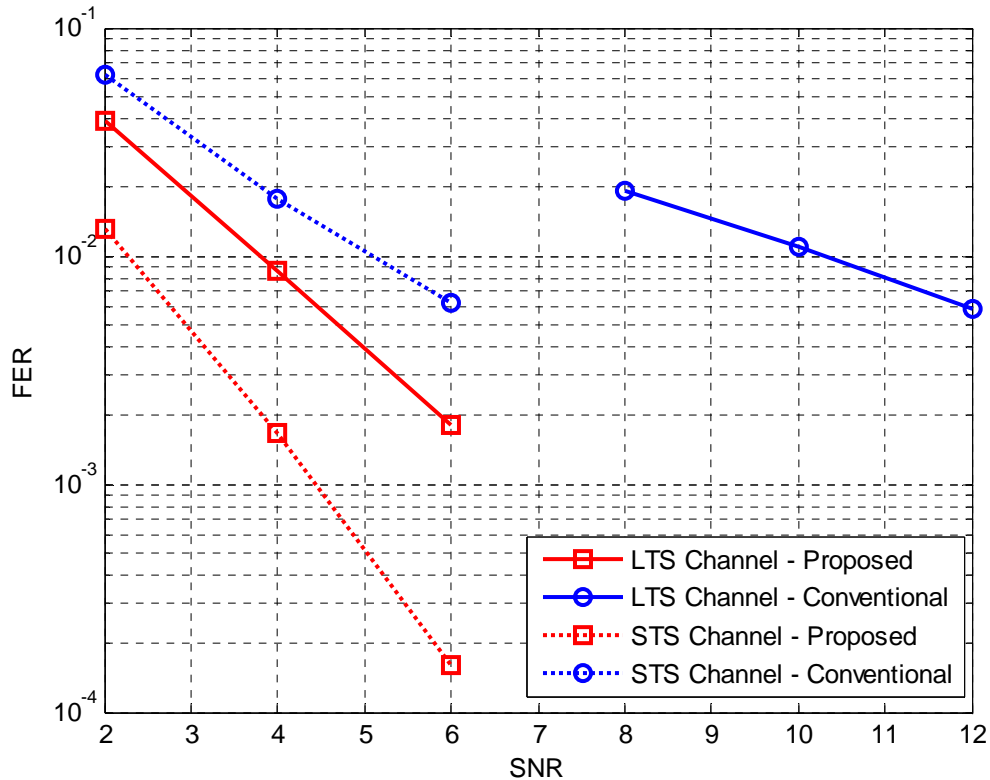
**STEP 4:**

Select the matrix which maximize effective SNR

$$\mathbf{F}_L^* = \arg \max_{\mathbf{F}_L \in S} f(\mathbf{H}_1, \dots, \mathbf{H}_L, \mathbf{F}_1, \dots, \mathbf{F}_{L-1}; \mathbf{F}_L)$$

Objective Function

# Error Performance for 2<sup>nd</sup> Transmission



Parameters	Value
Channel	Short-Term-Static (STS) & Long-Term-Static (LTS)
Codebook	IEEE 802.16e 3bit codebook
Antenna	4 Tx & 2 Rx antennas
Spatial Correlation	Urban macro in 16m EMD
Subcarrier Allocation	Localized mode (14 subcarriers)

# Proposed Texts for SDD

- 11.x Hybrid ARQ

In a codebook-based closed-loop MIMO system, linear precoding matrix for retransmission can be selected by taking symbol level combining gain with previous reception into account. In this HARQ process, NAK message and the corresponding precoding matrix index must be jointly signaled in the uplink control channel. Therefore, the message which is not received successfully in the initial transmission is retransmitted by using the precoding matrix reported along with NAK.