

Transceiver Architectures in Multiuser MIMO Environments with Different Power Allocations

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Abstract— In this paper we present efficient MIMO transceiver architectures evaluated in a multiuser environment. In this context we consider traditional MIMO transmit structures and also hybrid ones proposed in [6] capable of achieve diversity and multiplexing gains. Our results shown that in a multiuser environment the MIMO transmit structures of the desired user has a crucial impact in the performance due the diversity orders of the multiple layers in the MIMO structure.

Keywords— 4G, MIMO, diversity, multiplexy, multiple antennas, interference, multiuser.

I. INTRODUCTION

The main requirements that apply to fourth-generation (4G) mobile systems are support for high data rates and high quality of service (QoS). However, the mobile units must be smaller and with low complexity, being able to operate in different radio environments: macro, micro and picocellular; urban, suburban and rural; indoor and outdoor. As the available radio spectrum is limited, higher data rates can be achieved only designing more efficient transmission schemes. Thus, the next generation systems are supposed to have better quality and coverage, being more power and bandwidth efficient. In a multicell context, the increasing number of subscribers requires also a solution for inherent co-channel interference (CCI).

Wireless communication becomes extremely difficult in a multipath environment because the transmitted signal can be severely attenuated, decreasing the link performance. However, communication in wireless channels can be improved using multiple-input multiple-output (MIMO) transceiver architectures. The MIMO technology exploits the spatial components of the wireless channel to provide significant capacity gain and/or increase link robustness.

Some diversity techniques are widely used coupled with MIMO systems to reduce the effects of multipath fading environments and improve the transmission reliability without any increase of transmitted power or sacrifice of bandwidth. Space-Time (ST) coding is a transmit diversity technique which extracts diversity without any channel information at the transmitter. In this paper we consider the Space-Time Block Codes (STBC) [2], which generalizes the transmission scheme designed for two transmit antennas [1] and is present in evolved third-generation systems.

MIMO systems can be also used to spatially multiplex data in order to increase spectral efficiency. This gain in

multiplexing symbols through the MIMO wireless channel is known as Spatial Multiplexing (SM) gain, which increases almost linearly with the numbers of transmit antennas [4]. The multiplexing scheme adopted in this paper was the vertical Bell Laboratories Layered Space-Time (V-BLAST) [3], which splits the original data stream into substreams that are transmitted on the individual antennas.

It is known there is an important trade-off between diversity and multiplexing gains which explores the capacity of both structures [5]. Recently, new MIMO transceiver architectures named Hybrid MIMO Transceiver Schemes (HMTS) [6] using jointly ST and SM structures have been proposed to obtain advantages of both diversity and multiplexing gains. The rationale of the HMTS considers a layered architecture as V-BLAST, but some layers are coded with SBTC.

Several works have already studied the capacity of MIMO transceivers discussed previously. However, most of works do not consider CCI and in a typical cellular radio application, the performance-limiting impairment is the frequency reuse from the other cells (co-channel) that transmit in the same frequency of the desired user. In this context, not considering this multicell system feature is a non-real assumption. The value of CCI mitigation in wireless networks is that it enables better frequency reuse and hence improves networks spectrum efficiency.

In this context, a CCI canceling method using a MIMO spatial filter based on Minimum Means Square Error (MMSE) is introduced to suppress CCI placed before the decoder. This method was proposed in [7] for the Alamouti's STBC scheme. In this paper, we analyze the performance of this CCI canceling method for different MIMO transceiver schemes, namely STBC, V-BLAST and HMTS, over different power levels of the interferer user.

The organization of this paper is as follow. In Section II we show the system model proposed for a multiuser MIMO environment. The transmitter and receiver schemes are presented in Section III and IV jointly with mathematical demonstration, respectively. Simulation results are given in Section V and, finally, our conclusions are drawn in Section VI.

II. SYSTEM MODEL

We consider a multiuser (MU) environment with three transmit antennas and N receive antennas at the remote unit of the desired user. We consider the signal which introduces co-channel interference (CCI) is also sent by three antennas. A system figure is presented in Fig. 4.

At the transmission branch of the desired user, we might use a Spatial-Time Block Code (STBC), Vertical Bell Labo-

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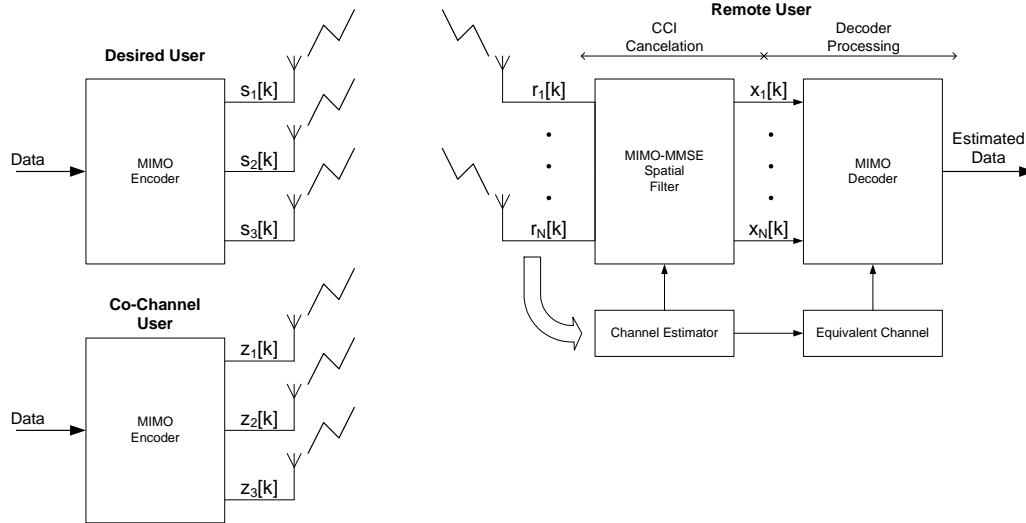


Fig. 1. System model general structure.

ratories Layered Space Time (V-BLAST) or a Hybrid MIMO Transceiver scheme (HMTS) to encode the symbols.

Each coded symbol is transmitted over a quasi-static rich-scattered flat fading channel from a different antenna. The fading between each transmit and receive antenna pair is assumed to be independent, modeled by circularly symmetric Gaussian random variables. The total transmitted power is fixed and the transmitted burst has length L , defined as the time over the channel is quasi-static.

At the interferer transmit branch we assume a single MIMO transceiver scheme and the same channel model. The interferer signal arrives at the receptor with a power level P_i considered in the system model. Thus, at any time-instant k the received signal can be expressed as

$$\mathbf{r}[k] = \mathbf{H}\mathbf{s}[k] + \sqrt{P_i}\mathbf{G}\mathbf{z}[k] + \mathbf{n}[k], \quad (1)$$

where $\mathbf{H}_{N \times 3} = [\mathbf{H}^{(1)} \ \mathbf{H}^{(2)} \ \mathbf{H}^{(3)}]$ denotes the MIMO channel matrix and the column vector $\mathbf{s}[k]$ denotes each row of the coded matrix of complex transmitted symbols $\mathbf{S}_{3 \times T}$. This coded matrix is constant over a signaling period, defined as the number of time slots to transmit the coded block and represented by T . The matrix \mathbf{G} and the vector $\mathbf{z}[k]$ are similarly defined for co-channel interferer signal. The matrix $\mathbf{n}_{N \times 1}$ is a zero-mean, unit variance and complex-Gaussian distributed noise that is spatially and temporally white.

Our general model considers an spatial filter based on Minimum Mean Square Error (MMSE) for interference canceling (IC) at the receiver structure before the decoder. After this previous filtering, the signal represents an estimation of the desired signal, ready to be decoded as follows:

- Using STBC decoder [2], if the transmitter uses a STBC scheme;
- Using linear or non-Linear detection scheme, if the transmitter uses a V-BLAST scheme;
- Using schemes coupled, if the transmitter uses a hybrid scheme.

It is important to remember that our model considers that the receiver knows both desired and interferer channels information.

III. MIMO SCHEMES FOR $M = 3$ TRANSMIT ANTENNAS

We have chosen three possible configurations for the scenario previously described. We assume that the interfering transmitter uses a MIMO hybrid scheme G2+1 [6], without any loss of generality. We detail these three possibilities for the transmitter.

A. Space-Time Block Coding

Space-time codes use channel coding techniques combined with multiple transmit antennas, introducing temporal and spatial correlations into signals transmitted from different antennas. We now present the first proposed STBC scheme, called G3 [2]. This scheme employs a three-element transmit antenna array which are space-time coded. The transmitted signals can be organized in the equivalent space-time coding matrix given by

$$\mathbf{S}_{G3}[k, \dots, k+7] = \begin{bmatrix} s_1 & s_2 & s_3 \\ -s_2 & s_1 & -s_4 \\ -s_3 & s_4 & s_1 \\ -s_4 & -s_3 & s_2 \\ s_1^* & s_2^* & s_3^* \\ -s_2^* & s_1^* & -s_4^* \\ -s_3^* & s_4^* & s_1^* \\ -s_4^* & -s_3^* & s_2^* \end{bmatrix}, \quad (2)$$

where the spatial dimension varies column-wise and the temporal dimension row-wise. Since T time slots are used to transmit P information symbols, we define the effective spectral efficiency equal to $\eta = \frac{P}{T} \cdot \log_2 \mathcal{M}$ bps/Hz, where \mathcal{M} is the modulation cardinality.

From Eq. (2), it can be seen that 3 symbols are transmitted in each time slot k and the encoder takes 4 information symbols in each encoding operation. Using the G3 scheme,

the number of time slots required to transmit the space-time coded symbols through the multiples antennas is 8, giving a code rate of $1/2$ and $\eta = \frac{1}{2} \cdot \log_2 \mathcal{M}$ bps/Hz.

We consider also in this work another STBC scheme called H3 [2], which has an equivalent space-time coding matrix given by

$$\mathbf{S}_{H3}[k, \dots, k+3] = \begin{bmatrix} s_1 & s_2 & \frac{s_3}{\sqrt{2}} \\ -s_2^* & s_1^* & \frac{s_3}{\sqrt{2}} \\ \frac{s_3^*}{\sqrt{2}} & \frac{s_3^*}{\sqrt{2}} & \frac{-s_1 - s_1^* + s_2 - s_2^*}{2} \\ \frac{s_3^*}{\sqrt{2}} & -\frac{s_3^*}{\sqrt{2}} & \frac{s_2 + s_2^* + s_1 - s_1^*}{2} \end{bmatrix}. \quad (3)$$

Similarly, using H3 scheme we obtain a code rate of $3/4$ and $\eta = \frac{3}{4} \cdot \log_2 \mathcal{M}$ bps/Hz. Both H3 and G3 schemes provide diversity gain.

B. Space Multiplexing Scheme

Another approach for multiple-antenna transmission is to focus on the maximization of the transmission rate. To obtain this goal, we consider the V-BLAST scheme, where all the antennas are used to multiplex different symbols in each time slot. In this scheme each different multiplexed symbol at a signaling period is defined as a layer. In the case of three transmit antennas we have three layers. The transmitted signals at time instant k , considering three transmit antennas, can be organized in the equivalent space-time coding matrix

$$\mathbf{S}_{V-BLAST}[k] = \begin{bmatrix} s_1 & s_2 & s_3 \end{bmatrix}. \quad (4)$$

As spatially-multiplexed symbols cause interference in each other, signal processing is mandatory at the receiver in order to cancel interference from each layer and from co-channel interferer. Using V-BLAST pure we obtain a multiplexing gain proportional to the number of transmit antennas, in this case equals to 3, resulting in $\eta = 3 \cdot \log_2 \mathcal{M}$ bps/Hz.

C. Hybrid MIMO Scheme

As seen in the last two subsections, MIMO antenna systems may provide diversity gain, using a STBC scheme, or multiplexing gain using V-BLAST scheme. There is, however, a trade-off: the diversity gain can only be increased if the multiplexing gain is sacrificed [5]. Hybrid MIMO transceiver schemes (HMTS) combine pure diversity schemes with pure spatial multiplexing schemes. In hybrid systems, some layers are space-time coded and, for the remaining layers, a V-BLAST approach is used. With this idea, hybrid MIMO schemes achieve a compromise between spatial multiplexing and transmit diversity gains [6].

We have chosen in this work the hybrid scheme G2+1, which employs a three-element transmit antenna array with two spatial multiplexing layers. A standard G2 space-time block code is used at the first layer and the other layer is not space-time-coded, following the V-BLAST approach. In the G2+1 scheme, the transmitted signals can be organized in the equivalent space-time coding matrix

$$\mathbf{S}_{G2+1}[k, k+1] = \begin{bmatrix} s_1 & s_2 & s_3 \\ -s_2^* & s_1^* & s_4 \end{bmatrix}, \quad (5)$$

where the spatial dimension varies column-wise and the temporal dimension row-wise.

From Eq. (5), it can be seen that 4 information symbols (two from each multiplexing layer) are transmitted in 2 time slots, given an effective spectral efficiency equal to $\eta = 2 \cdot \log_2 \mathcal{M}$ bps/Hz.

IV. MIMO RECEIVING STRUCTURES WITH CCI MITIGATION

Considering our system model, the incoming signal arriving at the receiver is the superposition of an interfering signal from co-channel with different power levels and the desired signal.

A receiving architecture based on a MMSE spatial filter to interference cancellation coupled with a decoder scheme to estimate each transmitted symbol was previously proposed [7] when the transmitter uses Alamouti's scheme. In this section we describe this MMSE IC algorithm coupled with decoder for each transmission MIMO scheme considered in this work.

A. CCI Mitigation with MMSE Spatial Filter

The idea behind a simple MMSE IC algorithm is minimizing the mean square error between the desired signal and MMSE filter output. At each instant k the MMSE filter output is expressed as

$$\mathbf{x}[k] = \mathbf{W}_{IC}^H \mathbf{r}[k], \quad (6)$$

where $\mathbf{W}_{IC} = [\mathbf{w}_1 \dots \mathbf{w}_N]$ with $\mathbf{w}_n = [w_1 \dots w_N]^T$ is a $N \times N$ matrix for the spatial filter coefficients. In a multiuser context the desired signal will be the ST coded or SM symbols and the error signal can be represented by

$$\mathbf{e}[k] = \mathbf{W}_{IC}^H \mathbf{r}[k] - \mathbf{r}_d[k] = \mathbf{W}_{IC}^H \mathbf{r}[k] - (\mathbf{H}\mathbf{s}[k] + \mathbf{n}[k]) \quad (7)$$

where $\mathbf{r}_d[k]$ represents the signal that would be received from the desired user if we had not considered the co-channel interferer. Thus, the MMSE cost function is expressed as follows

$$J_{MMSE} = E\{\|\mathbf{W}_{IC}^H \mathbf{r}[k] - \mathbf{r}_d[k]\|^2\}. \quad (8)$$

Minimizing the above cost function we found the optimal solution

$$\mathbf{W}_{IC} = \mathbf{R}_{rr}^{-1} \mathbf{R}_{rr_d}, \quad (9)$$

where $\mathbf{R}_{rr} = E\{\mathbf{r}[k]\mathbf{r}^H[k]\}$ and $\mathbf{R}_{rr_d} = E\{\mathbf{r}[k]\mathbf{r}_d^H[k]\}$ are the input covariance matrix and a cross-correlation matrix, respectively. We can write this optimal solution in another way considering that we have both channel knowledge as follow

$$\mathbf{W}_{IC} = (\mathbf{H}\mathbf{H}^H + P_i \mathbf{G}\mathbf{G}^H + \sigma_n^2 \mathbf{I}_N)^{-1} (\mathbf{H}\mathbf{H}^H + \sigma_n^2 \mathbf{I}_N). \quad (10)$$

After CCI minimization, the resulting MMSE filter output can be written as

$$\mathbf{x}[k] = \mathbf{H}' \mathbf{s}[k] + \mathbf{n}'[k] \quad (11)$$

where $\mathbf{H}' = \mathbf{W}^H \widehat{\mathbf{H}}$ is an equivalent MIMO channel matrix consisting of the original space-time coded channel modified by the coefficients of the MMSE filter. The term $\mathbf{n}'[k]$ is a spatially-colored noise vector containing filtered Gaussian

noise and residual interference, whose covariance is given by $\mathbf{R}_{n'n'} = \sigma_n^2 \mathbf{W}_{IC}^H \mathbf{W}_{IC}$. We could chose another CCI canceling filter but MMSE has a better performance than other linear filters, e.g. Zero Forcing (ZF) algorithm which do not suffer from noise enhancement.

B. MIMO Decoding Schemes after CCI mitigation

After CCI cancelation we are now able to estimate each transmitted symbol at the receiver for an specific MIMO transmission scheme. The MMSE filter output can be seen as a simple MIMO model considering the equivalent MIMO channel matrix \mathbf{H}' and defined in the end of the last subsection. In this subsection we describe the decoders for the MIMO schemes considered previously.

1) *G3 and H3 Decoder*: Taking the MMSE filter output we use a simple linear detection scheme based on each coding matrix, as shown in Fig. 2.

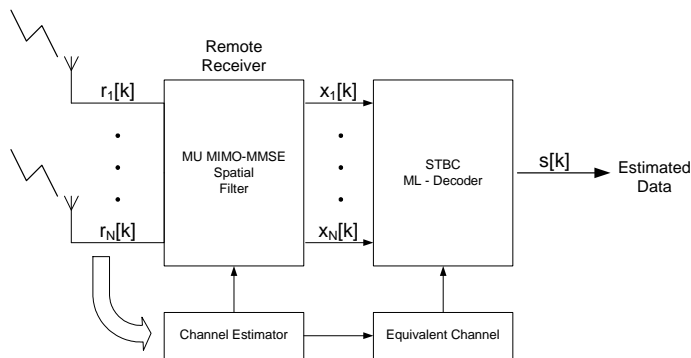


Fig. 2. Spatial Filter MMSE + STBC Decoder.

The incoming signals are combined in each transmission block period to decode the symbols information. Once the noise in $\mathbf{x}[k]$ is no more white, changed by the \mathbf{W}_{IC} filter, there is correlation between the samples. Based on the conditional probability density of $\mathbf{x}[k]$ [7], the maximum likelihood (ML) decoding of the space-time coded signal $\mathbf{s}[k]$ should be based on the minimization of the following branch metric

$$(\mathbf{x}[k] - \mathbf{H}'\mathbf{s}[k])^H \mathbf{R}_{n'n'}^{-1} (\mathbf{x}[k] - \mathbf{H}'\mathbf{s}[k]) \quad (12)$$

over all possible codewords of the space-time code used in the transmission.

This metric increases the decoding performance but raises its complexity. In our work we have assumed the Euclidian Distance as our decision metric, which simplifies our decoding process.

2) *V-BLAST Decoder*: The symbols multiplexed spatially interfere in each other, then some signal processing at the receiver has to be made in order to cancel interference. Linear methods were proposed and we have chosen to evaluate in this work a method based on MMSE estimation, as described previously to canceling the CCI.

In this case, the desired signal is $\mathbf{s}[k]$, giving the cost function written bellow

$$J_{\text{MMSE}} = E\{\|\mathbf{W}_{\text{VBLAST}}\mathbf{x}[k] - \mathbf{s}[k]\|^2\}. \quad (13)$$

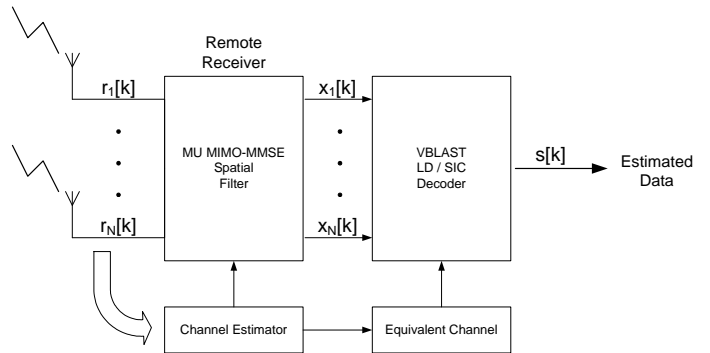


Fig. 3. Spatial Filter MMSE + V-BLAST Decoder.

After the minimization of the cost function, we have the spatial filter coefficients given by

$$\mathbf{W}_{\text{VBLAST}} = \mathbf{R}_{\text{sx}} \mathbf{R}_{\text{xx}}^{-1}, \quad (14)$$

where $\mathbf{R}_{\text{sx}} = E\{\mathbf{s}[k]\mathbf{x}^H[k]\}$ and $\mathbf{R}_{\text{xx}} = E\{\mathbf{x}[k]\mathbf{x}^H[k]\}$. Considering the equivalent MIMO channel \mathbf{H}' we have found another way to calculate the filter coefficients, resulting in

$$\mathbf{W}_{\text{VBLAST}} = \mathbf{H}'^H (\mathbf{H}'\mathbf{H}'^H + \mathbf{R}_{n'n'})^{-1}. \quad (15)$$

We can obtain a better performance using non-linear detection techniques to canceling the interference. Thus, we use a successful IC algorithm called successive interference cancelation (SIC) where the layers are detected sequentially. The incoming signal from the MMSE filter $\mathbf{x}[k]$ goes through a linear detector for the first layer, whose output is used to produce a symbol estimation at this layer $\hat{\mathbf{s}}_1[k]$. Then, this estimation is reduced of the incoming signal for the second layer, generating the signal $\mathbf{x}_2[k]$. The process is repeated successively for each layer, and the signal $\mathbf{x}_i[k]$, hopefully free from the interference of the other $j < i$ layers, goes through a linear filter that tries to canceling the interference from layers $j > i$. Based on the linear filter output, a symbol estimate $\hat{\mathbf{s}}_i[k]$ is produced and the received signal for each layer $\mathbf{x}_i[k]$ is also estimated with the interference from the remaining $j > i$ layers. This procedure is shown bellow

$$\mathbf{x}_{i+1}[k] = \mathbf{x}_i[k] - \hat{\mathbf{s}}_i[k]\mathbf{h}_i[k], \quad (16)$$

where \mathbf{h}_i is the i -th column of the equivalent matrix channel \mathbf{H}' corresponding to the equivalent channel gains associated to layer i , and $\hat{\mathbf{s}}_i[k]\mathbf{h}_i[k]$ represents the estimated equivalent interference from the i -th layer. This technique is also known as nulling and canceling algorithm [8].

3) *HMTS Decoder*: We have seen that a hybrid MIMO scheme with three transmit antennas divide the antennas into two layers, one V-BLAST layer to obtain spatial multiplexing gain and an STBC to increase the diversity gain.

Once the CCI have been already filtered, the incoming signal $\mathbf{x}[k]$ is a superposition of these two layers. In the case of G2+1, hybrid scheme evaluated in this work, we have a standard G2 code block at the first layer and a pure V-BLAST scheme at the other layer. We can use linear or non-linear detection to separate the two layers.

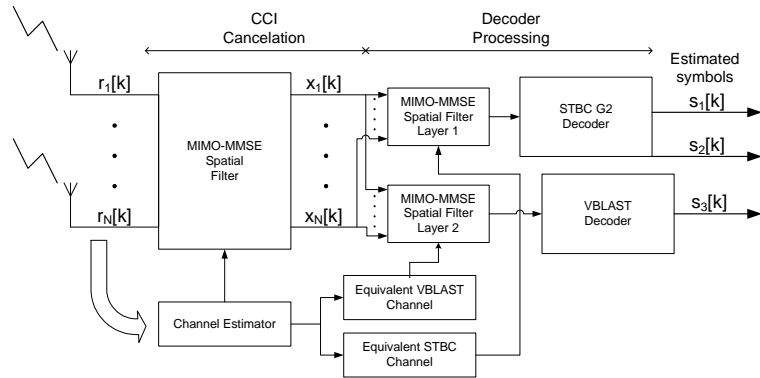


Fig. 4. Spatial Filtering MMSE + HMTS Decoder G2+1.

In linear detection, another MMSE filter represented by \mathbf{W}_1 is used for the first layer and the output error vector is

$$\mathbf{e} = \mathbf{W}_1 \mathbf{x} - \mathbf{x}_d^{(1)}, \quad (17)$$

where $\mathbf{x}_d^{(1)} = [\mathbf{H}'^{(1)} \mathbf{H}'^{(2)}] \mathbf{S}_1$. Here, \mathbf{S}_1 is the G2-encoded signal.

The goal of \mathbf{W}_1 is to remove the interference from other layers. This MMSE cost function may be written as

$$J_{\text{MMSE}} = E\{\|\mathbf{W}_1 \mathbf{x}[k] - \mathbf{x}_d^{(1)}[k]\|^2\}. \quad (18)$$

The optimal coefficients are found by minimizing the above cost function with respect to \mathbf{W}_1 . The solution is given by

$$\mathbf{W}_1 = \mathbf{R}_{\mathbf{x}_d^{(1)} \mathbf{x}} \mathbf{R}_{\mathbf{x} \mathbf{x}}^{-1}, \quad (19)$$

which can be represented by

$$\mathbf{W}_1 = (\mathbf{H}'^{(1)} \mathbf{H}'^{(1)H} + \mathbf{H}'^{(2)} \mathbf{H}'^{(2)H}) (\mathbf{H}' \mathbf{H}'^H + \mathbf{R}_{n' n'})^{-1}. \quad (20)$$

This second spatial filter makes no attempt to recover the G2-encoded signal: this will be done exploiting the structure of the STC, which leads to a linear receiver that performs ML detection.

The process to detect the V-BLAST layer is similar. Although, the input channel matrix to calculate the filter coefficients will be the remaining column, thus the \mathbf{W}_2 can be expressed as

$$\mathbf{W}_2 = \mathbf{R}_{\mathbf{x}_d^{(2)} \mathbf{x}} \mathbf{R}_{\mathbf{x} \mathbf{x}}^{-1}, \quad (21)$$

where $\mathbf{x}_d^{(2)}[k] = \mathbf{H}'^{(3)} \mathbf{S}_2$.

The procedure to find the filter coefficients is just the same as before, minimizing the cost function

$$J_{\text{MMSE}} = E\{\|\mathbf{W}_2 \mathbf{x}[k] - \mathbf{x}_d^{(2)}[k]\|^2\} \quad (22)$$

which results in

$$\mathbf{W}_2 = (\mathbf{H}'^{(3)H}) (\mathbf{H}' \mathbf{H}'^H + \mathbf{R}_{n' n'})^{-1} \quad (23)$$

This solution using a linear detection scheme is presented in Fig. 4. Another alternative is using a non-linear SIC scheme, where the MIMO MMSE output $\mathbf{x}[k]$ passes just as before by the G2+1 decoder to estimate the symbols from the first layer. The difference is that the \mathbf{W}_1 filter output will be canceled on the second layer before calculate the \mathbf{W}_2 filter coefficients.

In the next section we evaluate the performance of each algorithm and the simulation results.

V. SIMULATION RESULTS

We present the performance in terms of bit error rate (BER) vs. E_b/N_0 in dB by means of numerical results from Monte-Carlo simulations. Unless otherwise noted, all schemes employ binary-phase shift-keying (BPSK) modulation. We assume a MIMO system with 3 transmit and N receive antennas and one interferer user in different power allocation situations and receiver structures, linear detector (LD) and SIC receiver.

Fig. 5 shows the performance of G3 MIMO STBC transmit scheme considering $N = 4$ and two different power allocation for the interferer user. As it have been attempted, we can obtain a great performance for adverse link situations such as low SNR levels and high CCI.

The next graphic presented in Fig. 6 shows V-BLAST MIMO transmit scheme considering the power of the interferer such as SIR=10dB for different number of receiver antennas, $N = 4, 5$ and 6. We can see that using $N = 4$ receiver antennas is the overloaded case (also called undetermined) since we have more interference than antennas to null out each interference (CCI and interference from other layers) for both receivers LD and SIC. Considering SIC a gain is obtained compared with LD, since the last layer will perceive a diversity gain, thus, the already detected layers is nulled from the received signal. Even, with $N = 5$ receive antennas we have a overloaded case. However, with $N = 6$ we can null out the interferences and SIC provides a diversity gain by the nulled contribution of the detected layers adding diversity to the system. Figure 7 shows the performance considering a SIR=15dB. This is a less restrictive scenario and compared with the case of SIR = 10dB, it presents a lower BER.

Figure 8 shows the performance of G2+1 MIMO transmit scheme with a SIR = 15dB. Comparing with Fig. 7, we can see that its BER is lower for the same SIR level. We can explain this behavior due to fact that with G2+1 we just have two layers and one of them is a STBC G2. Thus, using SIC receiver for example, after the detection of the first layer all receiver antennas can be used to provide diversity gain increasing the performance of this layer and indirectly the performance of the whole receiver. Thus, depending of the number of layers in a MU scenario makes a lot of difference in the receiver performance.

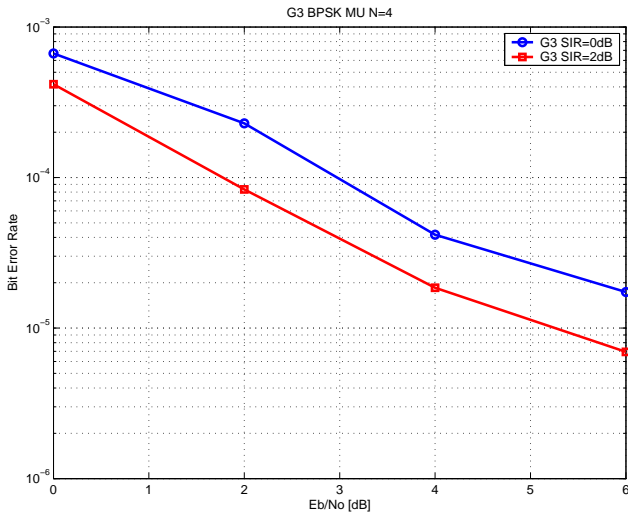


Fig. 5. Bit Error Rate versus SNR for G3 Scheme for SIR=0db and SIR=2dB.

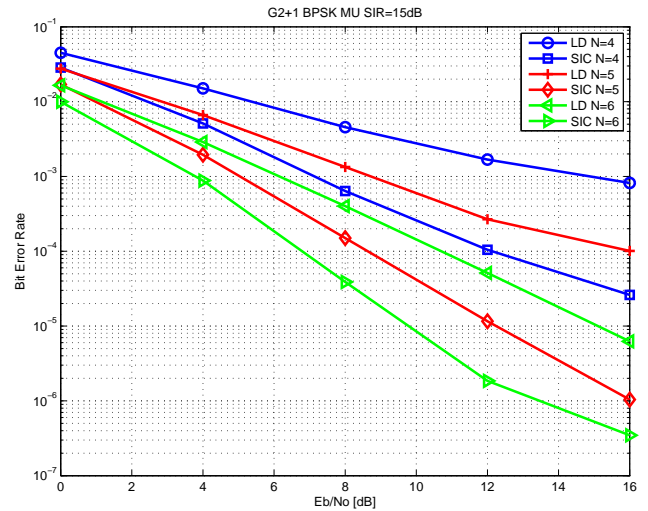


Fig. 8. Bit Error Rate versus SNR for G2+1 Scheme and SIR=15dB.

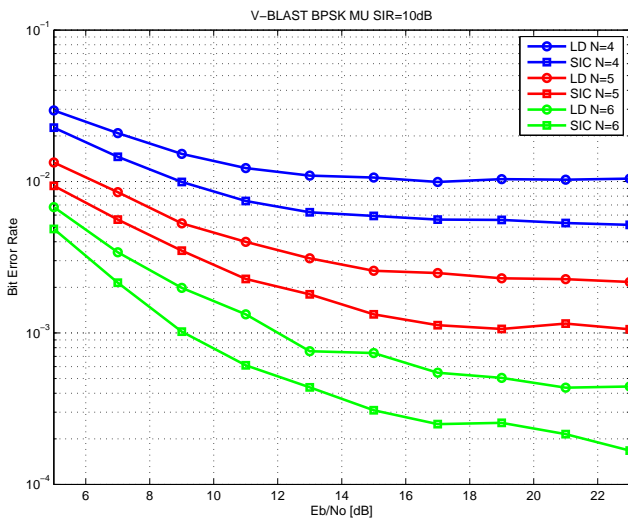


Fig. 6. Bit Error Rate versus SNR for V-BLAST Scheme and SIR=10dB.

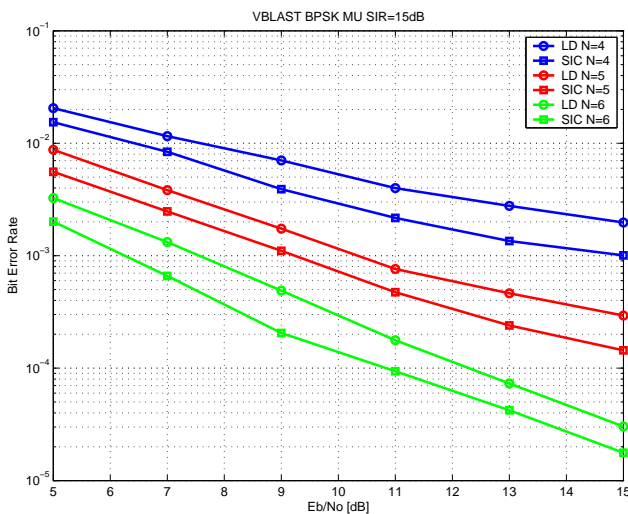


Fig. 7. Bit Error Rate versus SNR for V-BLAST Scheme and SIR=15dB.

VI. CONCLUSIONS

In this work we evaluated MIMO transceiver architectures in multiuser MIMO environments, thus, CCI is present with varying power levels. In this MU scenario the performance depends of the transmit architecture considered to the desired user, G2+1 architecture outperforms V-BLAST since, G2+1 has lower layers and this increase the diversity order to the last layer to be detected.

We have seen that the MMSE spatial filter can be also employed for CCI cancelation when the transmitter uses V-BLAST or HMTS schemes obtaining good performance, not only for STBC as shown in [7].

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