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Relay Selection with JNCC for Multiple Access Relay Channel

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ABSTRACT: In this paper, we consider the design of joint network Channel coding (JNCC) and relay selection (RS) in Multiple Access relay channels. In the proposed schemes, two users first sequentially broadcast their respective information to all the relays. We propose RS schemes, a single relay selection with JNCC ,which combines Turbo codes channel coding and random linear network coding through iterative joint decoding. For this scheme, the selected relay(s) perform JNCC on the received signals sent from the two users and forward them to both users. The proposed schemes are analyzed and the exact bit error rate (BER)and Symbol Error rate (SER) expressions are derived and verified through Simulations. Through analysis and simulation, we demonstrate the significant performance improvement of B-JNCC with relaying schemes.

KEYWORDS: JNCC, Channel coding (Turbo Code), Multiple access relay channel (MARC) Network Coding , BER, SER

I. INTRODUCTION

Wireless channels typically suffer from time varying fading caused by multipath propagation and Doppler shifts, resulting in serious performance degradation. Diversity has been an effective technique in combating channel fading. Recently, a new form of diversity technique, called user cooperative diversity [1], has been proposed for wireless networks. The idea is to allow users to communicate cooperatively by sharing their antennas to achieve a spatial diversity gain. The use of relay aided transmission is one example of a practical cooperative diversity technique. In a relay system, the source Sends its information to the relays. The relays then process the received signals, and forward them to the destination. At the destination, by properly combining the received signals sent from the source and relays, cooperative diversity can be achieved. It has been shown that cooperative communications can dramatically improve the system capacity and performance
[3], [4].

To further improve the network capacity, the application of network coding (NC) [2] in wireless relay networks has recently drawn significant attention. In particular, NC has been studied in multiple access, multicast and two-way relay channels, where two users communicate with each other with the help of relays [5]–[9]. Some physical layer NC schemes,
joint network-channel coding and scheduling algorithms, etc, have been proposed [5]–[9], [15]–[20]. It has been shown that properly designed NC can achieve significant capacity improvement in cooperative wireless networks. Most of the current work on Multiple Access relay channels considers the use of a single relay node to aid communication in the system [5]–[9]. In this paper, we consider a Multiple Access relay system with multiple relay nodes. In multiple relay networks, if all relays participate in the relayed transmission, it is usually assumed that they

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transmit on orthogonal channels so that they do not cause interference to each other [3], [4]. Relaxing the orthogonality constraint can lead to a capacity increase with an increased system complexity. To overcome these problems, relay selection algorithms using various relay protocols, such as amplify and forward, decode and forward (DAF), and their variations, have been proposed to facilitate system design for one way non-orthogonal multiple relay networks [10]–[12], [27]. A commonly used relay selection strategy in one way relay networks is to select a single best relay, which has the optimal end to end performance or capacity among all relays [10]–[12], or among all relays whose received signal-to- noise ratios (SNRs) are larger than a threshold [27]. It was shown that the single relay selection can achieve the full spatial diversity order as if all relays are used. Furthermore, the system bit error rate (BER) performance and capacity compared to all-participation relaying schemes is improved [3], [4].

In this paper, we consider the design of relay selection for Multiple Access relay channels. In [21], an interesting relay selection scheme was proposed for Multiple Access relay channels. The relay selection criterion was to maximize the weighted sum rate for any bidirectional rate pair on the boundary of the achievable rate region. It was shown that the probability that there exists one relay node which achieves the optimal rate pair decreases with increasing the number of relay nodes. The optimal relay selection criterion decides for any rate pair individually and the optimal rate region can be achieved by time-sharing of different relay nodes.

In this paper, we propose practical relay selection schemes for Multiple Access relay channels, designed to minimize the average sum bit error rate (BER) of the two end users in Multiple Access relay channels. We consider a decode and forward relaying protocol for information forwarding. To improve the spectral efficiency and error performance of bidirectional relayed transmission, we combine relay selection (RS) and JNCC, and develop efficient joint relay selection and JNCC coding schemes (RS-JNCC).Based on certain selection criteria, a single relay is selected for transmission. The selected relay is most opportunistic among all pairs for relaying a signal to destination. This is depending on the SNR of the channel link between the sources and relays node. Rj^{best} may be a more suitable relay will prefer to complete the transmission. The selection of the best relay is not based upon a distance since a communication link between transmitter and receiver locating in the same distance might have enormous difference in terms of receive the signal due to fading and shadowing.. In this paper, we will derive the exact closed-form and asymptotic SER expressions, and the analytical results are verified by simulations

The performance of the proposed RS-JNCC schemes is analyzed and verified by simulations. Results show that RS-JNCC schemes can achieve the full diversity order as if all relays are used. This is different from the conventional one way relay networks [10]–[12] where the single relay selection is the optimal selection strategy. This implies that a properly combined joint network channel coding and relay selection can improve both system performance and spectral efficiency.

The rest of the paper is organized as follows. The system model is described in Section II. In Section III, The joint network channel coding for multiple access relay channel is described The performances of these schemes are analyzed and the results are verified by simulations in Section IV and V In Section VI, we draw the conclusions.

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II TOPOLOGY AND PRELIMINARIES

2.1 Topology

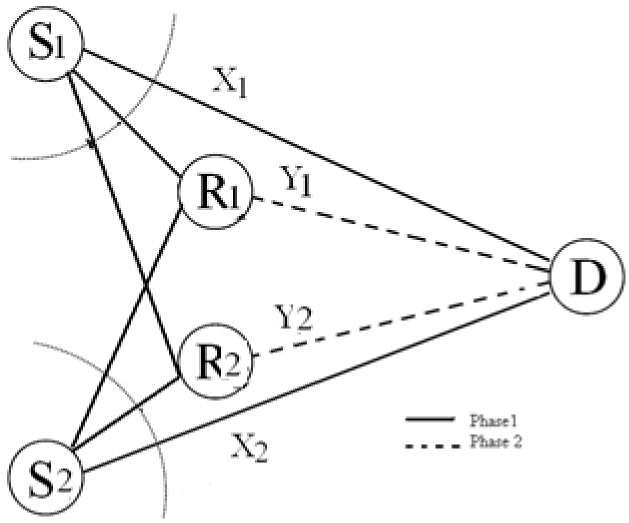

Fig.1. A simple topology with two sources, Multiple access relays and one sink

We first consider a simple two-source two-relay topology as shown in Fig. 1. In this topology, two sources, *S*1 and *S*2, transmit two independent packets, x1 and x2, to a common sink, D, with the help of Multiple relays, *R*1 and *R2*. To focus on the joint decoding procedure at the sink node, we assume the channels between the sources and the relays are lossy. This simple topology is used to demonstrate the benefit of the proposed scheme; extensions to large complex topologies with all lossy channels. Upon receiving x1,x2 the relays *R*1, *R*2, …Rj will forward redundant packets, y1,y2 (whose contents determine the level of collaborations), to the sink respectively. In this way, the sink node will see Number of packets, like x1 from source *S*1, x2 from source *S*2, and so on Then y1 from relay *R*1 and y2 from relay *R*2, and so on.In the optimal relay selection scheme, as shown by the solid line in Fig 1, each message transmits from the two source nodes takes place in two modes. In the first mode, both source nodes send the information to all relays simultaneously. In the second mode, best relay node is selected to forward the received signals to destination node. For the sake of simplicity, we assume that the source and the relay nodes have all the link information. An approximate formula for SER to pick the suitable relay according to the maximum SNR is presented.

2.2 Channel Model

We assume that all lossy channels suffer from slow fading: fading keeps constant across one packet and varies from packet to packet independently (a.k.a block fading). We model the channel as Rayleigh fading with additive white Gaussian noise:

$$y = hx + w; \qquad (1)$$

where $y \in C$, $x \in C$ and $w \in C$ denote the received signal, the

transmitted signal and the additive noise respectively, and $h \in C$ denotes the fading coefficient. Since $|h|$ follows the Rayleigh distribution, $|h|^2$ follows an exponential distribution with mean $\frac{1}{\lambda}$. Thus the probability density function (pdf) of $|h|^2$ can be written as:

$$p(z) = ¸e¡¸z \ (z = |h|^2): \qquad (2)$$

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Moreover, *w* is modeled as a zero-mean complex Gaussian random variable with two-dimensional variance *N*0. Then the transmit signal to noise ratio (SNR) can be defined as

$\gamma = {}^{E_b}/_{N_0}$, where $E_b = E\{|h|^2\}$.Thus the instantaneous receive signal to noise ratio is $|h|^2 = Eb|h|^2/N_0$ and the average receive signal to noise ratio is $\gamma E\{|h|^2\} = Eb/\lambda N_0$ .Here $E\{.\}$denotes the expectation operation.

2.3 Channel Coding

The channel coding strategy is explained in this section. The channel codes at source node1 contain a rate 1/2 recursive systematic convolution code with constraint length 4 and information bit block length *K* = 1500. The feed forward generator is 15, and the feedback generator is 13, both in octal. As the code is systematic, the output from the channel code contains 1503 systematic bits (including three tail bits) **v***i* and 1503 parity bits **p***i* where *i* {1, 2}. As we want to send *N* = 2000 code bits **x***i*, we puncture the parity bits **p***i* according to the following rule. We only transmit every third parity bit except the parity bits at position 373, 748, 1123 and 1498. This position is chosen such that the puncturing occurs regularly. The joint network-channel code consists of three constituent encoders, which are channel encoder 1 and 2 at the mobile stations form two of three constituent encoders.

2.4 Network Coding

If the relay has decoded the data of both source nodes correctly, the relay network encodes the estimates ˆ**u**14 and ˆ**u**24 and sends the network code bits **x**4 to the base station to provide additional redundancy for both uplinks.A network encoder of both estimates are interleaved according to [14]. Then, the interleaved bits appear alternately as the input of a convolutional encoder with the same parameters like the convolution code used as a channel encoder. However, the output from the network encoder contains only the 3003 parity bits of the convolutional encoder. As we only want to send *N*R = 2000 bits, we puncture every third bit and the bits at position 1000 and 2000. The network code of rate *R*R = (2.*K*)/*N*R = 1.5 provides *N*R additional parity bits, which support the decoding at the base station. Although the different coding operations are processed spatially distributed, we will treat them as one network-channel code with the system rate *RS* = 2 · *K*/(2 · *N* + *N*R) = 0.5 As they process the information bits in its original order, they are depicted in horizontal direction. The third constituent encoder is the network encoder at the relay. As it processes the interleaved information bits, it is depicted in vertical direction. The network encoder combines the information bits of MS 1 and MS 2. Therefore, the encoder at the mobile stations and at the relay form one spatially distributed code with increased cooperative diversity.

III. B-JNCD CODING AND DECODING FOR MULTIPLE ACCESS RELAY CHANNEL

In this section, we present the coding and decoding procedures of the proposed Binary-JNCD using the topology shown in Fig. 1. We assume that all packets and operations are based on symbols.

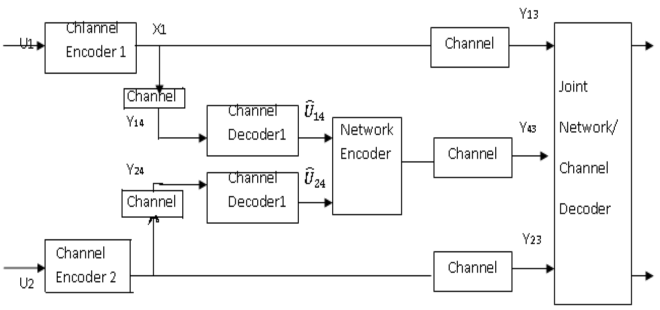

Fig.2 Block Diagram

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3.1 Code Construction

Referring to Fig. 1and Fig 2, we assume that source *S*1 generates a packet u1 with *k* symbols , then encodes it into x1 using a Turbo encoder specified by a generator matrix G1 of size *k X n* as:

$$x_1 = u_1G_1; \qquad (3)$$

where x_1 and u_1 are row vectors of length *n* and *k*

respectively. Thus the channel code rate is $r_c = k/_n$. Similarly, the packet generated at source S_2 can be obtained as $x_2 = u_2G_2$, where G_2 is the code generator matrix. For simplicity, we assume that the size of G_2 is also *k X n*. Thus the channel code rate is the same as that for source S_1.

Assume two packets x_1 and x_2 are broadcasted respectively to the relays and the sink uses orthogonal channels (at different time slots or via different frequencies). After receiving packets from the sources the relays first decode and obtain the original packets, then generate packets using network coding and channel coding. The two network codes at relays R_1 and R_2 are represented as

$$Y_{SRi} = \sum_{i=1}^{j} h_{s_{1,i}R_j} x_1 + h_{s_{2,i}R_j}\, x_2 + n_{SRi} \qquad (4)$$

$$Y_{SD} = h_{s_1 D}\, x_1 + h_{s_2 D}\, x_2 + n_{SD} \qquad (5)$$

Where $h_{s_1 R_j}$ denotes the channel gain between source and j-th relay terminals, $h_{s_1 D}$ denotes source and destination terminals respectively. *x* is the transmitted information symbol. The noise terms are n_{SRj}, n_{SD} modeled as zero-mean complex Gaussian random variables with variance N_0

$$Y_{R_i D} = \sum_{i=1}^{2} h_{s_{1i}} U_1 G_{1i} + h_{s_{1i}} U_2 G_{2i} + n_{RiD} \qquad (6)$$

Where $h_{R_j D}$ is the channel gain between j-th relay terminal and the destination.Packets Y_{SD} and $Y_{R_i D}$ will be sent to the sink from source and Relays respectively. At the sink node, four packets x1, x2, y1 and y2 will be received. The sink node forms a longer code as follows:

since $\quad x_1 = u_1G_1 \quad$ and $\quad x_2 = u_2G_2;$

$$[X_1 \quad X_2 \quad Y_1 \quad Y_2\ ] = [U_1 \quad U_2]\begin{bmatrix} G_1 & 0 & h_{s_{11}}G_{11} & h_{s_{12}}G_{12} \\ 0 & G_2 & h_{s_{21}}G_{21} & h_{s_{22}}G_{22} \end{bmatrix} \qquad (7)$$

Here we assume that the network coding coefficients can be conveyed to the sink without error. The code in (7) can be viewed as an integrated channel code with packets [u_1 u_2] and generator matrix G^1 which is specified by

$$G^1 = \begin{bmatrix} G_1 & 0 & h_{s_{11}}G_{11} & h_{s_{12}}G_{12} \\ 0 & G_2 & h_{s_{21}}G_{21} & h_{s_{22}}G_{22} \end{bmatrix} \qquad (8)$$

We define the network code rate *rn* as the fraction of original packets over all received packets at the sink. Then *rn* = 2/4

for the scenario discussed above. Thus, the integrated code isof rate $r = r_c r_n = \frac{r_c}{2}$

3.2 Relay Selection For Multiple Access Relay Channel

The transmission protocol requires two consecutive phases as follows. In the first phase, the encoded transmitted symbol X will be received by relay and destination. In the second phase, relay decides whether to forward the received information or not according to the quality of the received signal. If the relay decodes the received symbol correctly, then it forwards the decoded symbol to the destination. otherwise, it remains idle.

In single relay selection schemes, only one opportunistic relay transmits the received signal to destination. In previous work, opportunistic relay is defined considering distance toward source or destination [12] or considering the channel condition. In [13] best relay is selected based on a channel condition using analog network coding and DF schemes. In [14], authors select the best relay based upon the channel condition.

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In this paper, we are focusing best relay selection. In the second-mode of transmission, Best relay is selected out of N-relays to forward the received signals. Just a single source node (i.e., S) will determine the optimal relay according to a certain criterion and broadcast the index of it to all relays. Then, only the selected one, which is known by both source nodes, is active in the second mode of transmission, and the other keep idle.

Let $\propto_{SR}$ and $\propto_{Rd}$ denote the total channel power from source to relay and relay to destination respectively. Here, $\propto_{SR}$ and $\propto_{Rd}$ describe the quality of the wireless path between source to relay and destination to relay. $\propto_{SR}$ is calculated by relay by the following equation.

$$\propto_{SR} = |h_{11}|^2 + |h_{22}|^2 \text{ j=1} \tag{9}$$

and $\propto_{Rd} = |g_j|^2$ is the fading amplitude from relay to destination. Since Multiple access relay networks are important for end to end performance, After being selected as the best relay it relays a signal to destination. In this paper, we assume the destination has perfect channel state information available for decoding the received signal.

3.3 Iterative Network and Channel Decoding

A Joint iterative network and channel decoder at the base station is depicted in Fig.3. First, the channel decoders calculate extrinsic information $L_e^-(U_1)$ and $L_e^-(U_2)$ and The channel decoders contain a soft-in/soft-out (SISO) decoder for the channel encoders 1 and 2. They use the channel outputs y13 and y23.We include a value of zero for the punctured bits before the decoding starts. The log-likelihood ratios $L_e^-(U_1)$ and $L_e^-(U_2)$ are interleaved and mixed in the same way as it was done in the network encoder. The log likelihood ratios after the mixture are a priori knowledge for the network decoder which contains also an SISO decoder.

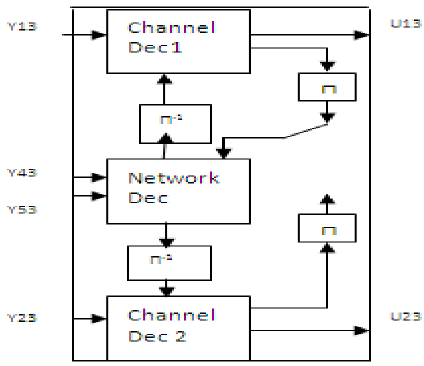

Fig. 3 Joint iterative network and channel decoder at the base station.

The network decoder obtains additional information about the parity bits from the channel output **y**43. The network decoder calculates extrinsic information $L_e^i(U_1)$) and $L_e^i(U_2)$ which is passed back to the channel decoders. After several iterations the channel decoders combine all available information to obtain the estimates ˆ**u**13 and ˆ**u**23. Note that the network decoder could deliver the estimates as well For simplicity, we assume that all the generator matricesG*i* (*i* =1*;* 2) and G*ij* (*i; j* = 1*;* 2) are the same, denoted as G. Now we can revise (7) as

$$\begin{bmatrix} X_1 \\ X_2 \\ Y_1 \\ Y_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ hs_{11} & hs_{12} \\ hs_{21} & hs_{22} \end{bmatrix} \begin{bmatrix} U_1 \\ U_2 \end{bmatrix} G = MX\ UX\ G \tag{10}$$

The whole decoding process can start with either channel decoding or network decoding. The decoding procedure continues round by round until all packets are correctly decoded or the maximum number of rounds is reached with a

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failure claimed. Except for the first round, a symbol node could combine the channel information and the updated *a priori* information from the network decoding component to perform channel decoding.

IV. PERFORMANCE ANALYSIS

Direct Transmissions with Relays (Single Relay) In this scheme, in addition to the direct transmissions to the sink, each source has one relay forwarding information for it. Thus, the network coding matrix M for this scheme becomes .

$$M^T = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix} \tag{11}$$

Binary Joint Network-Channel Decoding (Binary JNCD)

As most existing research (See Section 7) generates network codes applying binary XOR operation, we abstract these approaches as a binary joint network-channel decoding scheme.In Binary JNCD, the channel codes are the same as those used in NB-JNCD, while the network coding coefficients $h_{s_{11}} = h_{s_{12}} = h_{s_{21}} = h_{s_{22}} = 1$.Thus the network coding matrix M can be correspondingly presented as

$$M^T = \begin{bmatrix} 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \end{bmatrix} \tag{12}$$

In the 1st phase, both source nodes send the information to all relays simultaneously, the 2nd phase; best relay node is selected to forward the received signals to destination nodes based on equation 9 , then it transmits to destination. The selection of the best relay is done by identifying the weaker link between relay node. The weak link is ordered and the one which have largest SNR is selected as the candidate relay to perform detection and forward to destination.
In the following, we obtain analytical expressions for outage probability, and average symbol error rate.

Best Relay Selection

Considering N available relays, the relay selection algorithm selects the best relay (denoted relay b) such that

$$\gamma_b = \max_{i\in R}(\gamma_i) \tag{13}$$

where $R = \{1, 2, . . .,N\}$, γi is the instantaneous SNR for the

$$\gamma_b = \max_{i\in R}(\gamma_i) = \max_{i\in R}\{\min(\gamma_{SR_j,}\gamma_{R_jD})\} \tag{14}$$

Using the definition of the MGF given by

$$M_\gamma(s) = \int_0^\infty e^{-S\gamma} f_\gamma(\gamma)\, d\gamma \tag{15}$$

According to i.i.d links, the CDF expression can be written as. $F_{\gamma i}(\gamma) = 1 - e^{\frac{-\gamma}{\bar{\gamma}_v}}$therefore, the CDF of γ_b can be expressed as

$$F_{\gamma_b}(\gamma) = \left[F_{\bar{\gamma}_v}(\gamma)\right]^N = \left[1 - e^{\frac{-\gamma}{\bar{\gamma}_v}}\right]^N \tag{16}$$

The PDF $f_{\gamma_b}(\gamma)$ can be obtained by taking derivative of the CDF in (16) with respect to γ gives

$$f_{\gamma_b}(\gamma) = N f_{\bar{\gamma}_v}(\gamma)\left[F_{\bar{\gamma}_v}(\gamma)\right]^{N-1}$$

$$= N\frac{1}{\bar{\gamma}_v} e^{\frac{-\gamma}{\bar{\gamma}_v}}\left[1 - e^{\frac{-\gamma}{\bar{\gamma}_v}}\right]^{N-1} \tag{17}$$

Then, substituting (17) into (15) and using the binomial expansion and after some manipulations the MGF of γ_b can be expressed as

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$$M_{\gamma_b}(s) = \sum_{n=1}^{N} \binom{N}{n} \frac{n(-1)^{n-1}}{(n+\gamma_v s)(1+\gamma_{SD} s} \quad (18)$$

To find the PDF of γ_{up}, we use

$$f_{\gamma_{up}}(\gamma) = L^{-1}\{M_{\gamma_b}(s)\} = \int_0^{\infty} e^{sx} M_{\gamma_b}(s) ds \quad (19)$$

Where L^{-1} is the inverse Laplace transform operator. Substituting the MGF expression (18) into (19) yields

$$f_{\gamma_{up}}(\gamma) = \sum_{n=1}^{N} \binom{N}{n} \frac{n(-1)^{n-1}}{\gamma_v - n\gamma_{SD} S} \left(e^{\frac{-n\gamma}{\gamma_v}} - e^{\frac{-n\gamma}{\gamma_{SD}}}\right) \quad (20)$$

Then, we can obtain the CDF of γ_{up} by taking the integral of the PDF in (20) with respect to γ, yielding

$$F_{\gamma_{up}}(\gamma) = 1 + \sum_{n=1}^{N} \binom{N}{n} \frac{n(-1)^{n-1}}{\gamma_v - n\gamma_{SD} S} \gamma_{SD}\, e^{\frac{-n\gamma}{\gamma_{SD}}} - \frac{\gamma_v}{n} e^{\frac{-n\gamma}{\gamma_v}} \quad (21)$$

Average symbol error rate

We derive the average SER expressions for BPSK modulation scheme. Due to the use of MGF of upper bound SNR, the average SER for binary signals is given by

$$\overline{SER} = \frac{1}{\pi} \int_0^{\frac{\pi}{2}} M_{\gamma_b}\left(\frac{g}{\sin\theta^2}\right) d\theta \quad (22)$$

Where g=1 for BPSK. Substituting (18) into (22) and after some manipulations, the average SER in this case can be expressed as.

$$\overline{SER} = \sum_{n=1}^{N} \binom{N}{n} (-1)^{n-1} *$$

$$\frac{1}{\pi} \int_0^{\frac{\pi}{2}} \left(\frac{\sin^2\theta}{\sin^2\theta + c_1}\right) \left(\frac{\sin^2\theta}{\sin^2\theta + c_2}\right) d\theta \quad (23)$$

Where $C_1 = g\gamma_{R_j}$ and $C_2 = g\gamma_{SD}$.Using partial fraction expansions and after some manipulations (23) for the BPSK signaling can be written in closed- form expression as

$$\overline{SER} = \sum_{n=1}^{N} \binom{N}{n} \frac{(-1)^{n-1}}{1-2n} \left[I_1\left(\frac{\gamma}{2n}\right) + 2nI_1(\gamma)\right] \quad (24)$$

$$I_1(C) = \frac{1}{\pi} \int_0^{\frac{\pi}{2}} \left(\frac{\sin^2\theta}{\sin^2\theta + C}\right) d\theta$$

$$= \frac{1}{2}\left(1 - \sqrt{\frac{C}{1+C}}\right)$$

equation (24) represents the average SER from relay selection.

Outage Probability

The outage probability is defined as the probability that the end-to-end SNR falls bellow a certain predefined threshold value, α The outage probability can be expressed as

$$P_{out} = \int_0^{\infty} f_{\gamma_b}(\gamma) d\gamma = F_{\gamma_b}(\alpha) \quad (25)$$

Therefore, using the CDF expression (21), *P*out can be written as

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$$F_{\gamma_{up}}(\gamma) = 1 + \sum_{n=1}^{N} \binom{N}{n} \frac{n(-1)^{n-1}}{\gamma_v - n\gamma_{SD}} \gamma_{SD}\, e^{\frac{-n\gamma}{\gamma_{SD}}} - \frac{\gamma_v}{n} e^{\frac{-n\gamma}{\gamma_v}} \qquad (26)$$

V. SIMULATION RESULTS

In this section, we provide the simulation results using MATLAB tools for the MARC model. Simulations have been performed to show the BER & FER performance of JNCC over the Rayleigh fading channels for without relay and with single relay in MARC. Fig. 4 and Fig. 5 depict the BER and FER performance. In the first mode where the two source node simultaneously transmits their own information to all the relays as well as the destination node. As the redundancy which is contained in the transmission of the relay is received with a higher SNR, it is more important to exploit it efficiently. The difference at an FER of 10^{-2} is 2.0 dB.

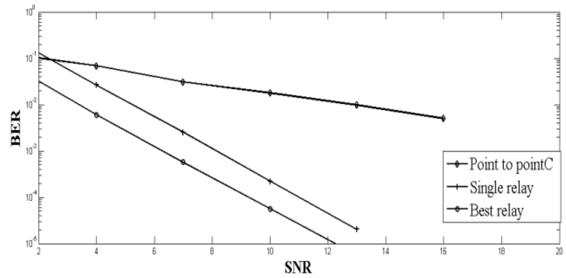

Fig.4 BER Vs SNR for Multiple Access Relay Channel at Nr=1 and **Nr=5**

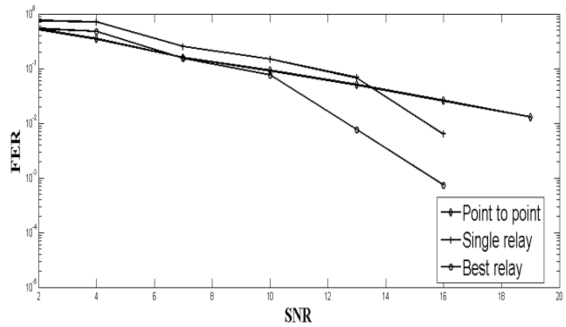

Fig.5 FER Vs SNR For Multiple Access Relay Channel At Nr=5 , Nr=1and Point To-Point

Fig.6 presents the simulation results for SER to pick a best relay among *nR*-relays nodes of JNCC strategies. and Fig.7 depicts the SER and Outage Probability as a function of SNR, where a single relay, i.e. best relay with a minimum symbol error rate (SER) will be selected to forward the new version of the received signal. Fig.6 shows the average of SER of the system model with JNCC for *N*-relays. We can observe that the average SER inversely proportional to a number of relays (i.e. *SER* decrease when the number of relay (increase).

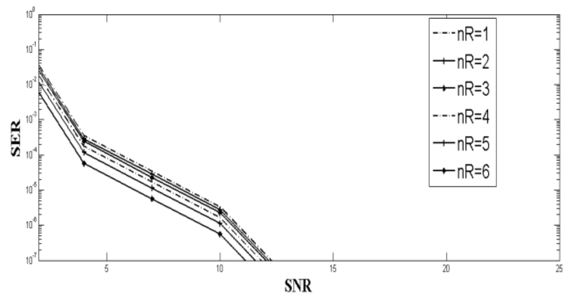

Fig.6 SER Vs SNR for MARC, where nR = 1, 2, 3, 4, 5.

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Fig.7 shows that the outage probability versus SNR results for the system model. We can observe from it that the number of relay nodes affect the outage probability (i.e. decrease).

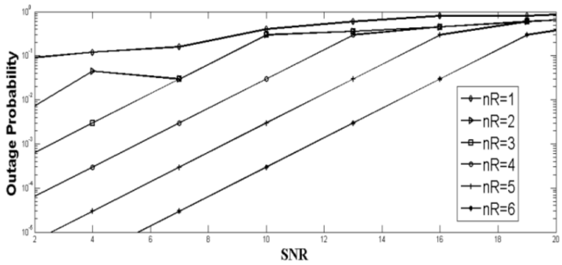

Fig.7 Outage Probability Vs SNR for MARC, where nR = 1, 2, 3, 4, 5.

VI. CONCLUSION

In this wok, we have proposed a relay selection with JNCC over G-MARC system. Such as the system could be used for the cooperative uplink for two sources to a destination with the help of the best relay .We showed with simulation results that increase in the number of relay channel increases cooperative diversity compared to the single relay channel. Simulation results show that the frame error rate of JNCC can outperform with the number of relays (nR=5). Single relay has of a performance loss of 3.0dB compared to the number of Relay (nR=5) for an FER of 10^{-2}. To improve the system performance, the best relay selection strategy is provided based on the SER.

As future work, we plan to pursue in the following directions:

1) Performance analysis of Relay selection with NB-JNCC for Two Way relay channel.2. carry out performance comparisons with related schemes in various network topologies.

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