SURVEY OF COOPERATIVE COMMUNICATION TECHNIQUES

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ABSTRACT:

Cooperative communication in wireless networks has become increasingly more appealing as of late since it could moderate the especially extreme channel impairments emerging from multipath propagation. Here the more noteworthy advantages picked up by abusing spatial diversity in the channel. Right now, outline on cooperative communication in wireless networks is introduced. We engrave the advantages of cooperative transmission than traditional non – cooperative communication. Functional issues and challenges in cooperative communication are distinguished. Specifically, we present an examination on the advantages, applications and distinctive routing strategies for cooperative mesh networks, Ad hoc networks and wireless sensor networks.

Key words: cooperative communication, Amplify and Forward (AF) and decode and forward (DF).

I.Introduction:

As of late, cooperative communication in wireless networks has become an alluring research topic. New-generation wireless networks have energized ongoing development in research in the field of cooperative communication [1]. Solicitations for expanding numbers of wireless applications have caused critical improvement in wireless networks, particularly cellular voice and data networks. All the more as of late, this development has been expanded to ad-hoc networks for wireless computers, homes and individual lives [1]. The following wireless network motivations will exceed the point-to-point or point-to-multi-point models of old style cellular networks. Instead, these motivations will be founded on connections among nodes in which they should help out each other so as to improve their communicative performance [2]. Cooperative communication dependent on relay nodes has gotten helpful for expanding spectral and power efficiency and network coverage, just as for diminishing the probability of outages [3]. Cooperative communication impacts the spatial diversity accessible in wireless networks by permitting two nodes to cooperate so as to improve by and large system performance [3]. BER performance will be improved fundamentally when the goal chain incorporates both the signal got from the source and the signal got from the relay hub [3].

An extremely testing process in wireless networks is a data transmission because of the few qualities, for example, signal fading, Bit error Rate (BER), Signal-to-Noise ratio - SNR, CSI and QoS. Such qualities required new improvements for data transmission. The data transmissions are delegated Amplify and Forward (AF) and decode and forward (DF), The target of this paper is to improve an understanding of the current systems of cooperative communication and its issues.

Fading of signal is a significant issue which restrains the performances. There are a few kinds of fading dependent on time and frequency variety. CDMA systems had a more noteworthy advantage than existing multiple access systems. Existing In 1999, CDMA utilized RAKE receiver. It had been utilized multiple correlators to identify M multiple segments separately. Be that as it may, this was the ideal arrangement for just the moderate fading plans and accomplish multipath diversity likewise it has lackluster showing under quick fading. The new CDMA conspire proposed in [11], which utilized Doppler RAKE Receiver demonstrated that Doppler is another part of diversity to battle fading. It was the new receiver structure for actualizing Doppler diversity.

Diversity methods may utilize the multipath propagation, which creates a diversity increase, estimated in terms of dB.The research has been expanded in demanding administrations because of expanding the number of clients. In numerous wireless systems, the possibility of diversity has been executed to diminish the impacts of wireless channel. The fading parameter could be diminished utilizing distinctive diversity strategies.

The paper is composed in the following steps. In the remaining section, the brief summarization given for diversity schemes. In the II section, the generalized model of transmit diversity has discussed. The III section, summarizes the general concepts of operative Communication. The IV, section describes the generalized cooperative techniques. In V, Section, , the paper concludes with a comparative discussion of the surveyed approaches also pointed out research problems.

II.System model

In the Fig.1. encoding has been done using space and time coding i.e. Two adjacent symbol eriod used as well as encoding can done in frequency and space coding i.e. Adjacent two carriers may used.

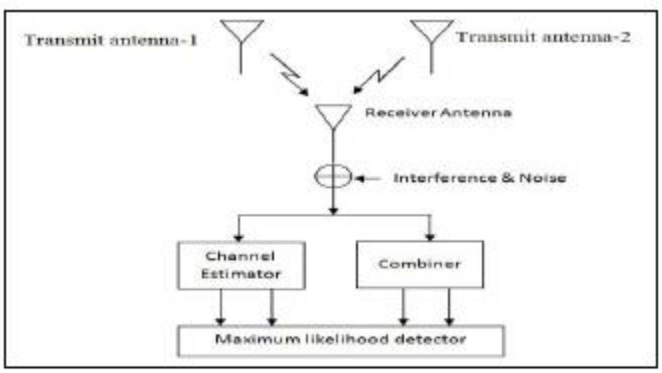

Fig1: Generalized system model used for simple transmit diversity technique

The proposed conspire [8] dependent on one receive and two transmit antenna is material for Rayleigh fast fading channels. Diverse transmission plans have created in [1] [9] [10] Space time coding is utilized to give the gain and diversity. Models for STC are: Space Time Trellis Codes[1] (STTC) and STBC [9] [10].Initially STC's were intended for just quasistatic fading channels. STTC proposed in[4], fading parameters can change symbol by symbol premise.

III. CO-OPERATIVE COMMUNICATION

In the years after the fact, communication has been begun with a cooperative relay selection which is called as cooperative communication with relay selection. In any case, the inquiry excited that when to participate and whom to coordinate with? The appropriate response is, the point at which the source used to transmit the message, anybody of the halfway relays received those messages. The piece of CSI accessible at the relay and source nodes assumes a noteworthy job in the selection of relays. The optimum relay is only the relay that has the highest gain of the channel. Cooperative communication is considered as a cheerful method to improve reliability and to build channel capacity in wireless networks. On the off chance that there are multiple relays, among the arrangement of accessible relays, just a solitary relay is initiated. This strategy is called selective relaying. Consequently, the resources accessible were utilized efficiently. Cooperative relaying has the benefits of diversity in wireless systems without utilizing multi antennas at both transmitter and receiver. The general protocols had created in [2]. Selection of Single-relay in Cooperative relaying based on a maximum SNR, which is known as opportunistic relaying (OR). A substitute technique to OR were utilized DSSC (distributed switch and stay combining). In DSSC, a relay is dynamic till it receives the sign with bigger SNR than the present SNR esteem. These OR and DSSC protocols, refers to selective Cooperative relaying where selection of a single relay takes place.

IV. CO-OPERATIVE COMMUNICATION TECHNIQUES:

Actually Cooperative communication advised the terminals of communication in a network to transmit the information between each other using broadcasting nature of the wireless Communications. It has been used to increase power, spectrum efficiency and improve network connectivity. When comparing with other techniques, cooperative communication is superior to other in its flexibility and hardware feasibility. In this section, we investigate or studied cooperative communication techniques. Several transmission techniques have been used for communication over relay channels. Now-a-days, the usage of cooperative transmission techniques has been increased due to its advantages such as more reliable communications and increased transmission rates. The following signal processing techniques of relays are considered such as Decode and forward (D&F) in which the messages sent by the source has been decoded and then encoded by the relay then that would be retransmitted to the receiving end node. Next is the AF technique where the messages sent by source have been amplify by the relay then it would be ready for forwarding to the receiving node.

A. Decode & Forward (DF)

Forward error correction is used to encode the datafrom source to receiving end. Then re-encoding and retransmission occurs to the receiving node if the relay receives message with no error. Then the destination combines the messages from source and relay for the purpose of reconstruction. The overall service quality of the cooperative system depends on the SNR, synchronization technique, samples used at the nodes.This cooperative relaying strategy is used for secure communication. Additional channels are required while introducing cooperative relays to transmit secret information.

Co-operative communications have been employed over past few years by means of overcoming the drawbacks of implementing MIMO systems. There are three types of relaying protocols such as half-duplex(HD) relaying protocols, two-path(TP) relaying protocols and two-way(TW) relaying protocols. Particularly, cooperative schemes are used to attain the largest diversity order. D & F technique has considered and analysed in this section under half-duplex, two-path and two-way relaying protocols. In half duplex relaying, D&F technique, the relays are able to decode messages from the source, then it forwards the decoded messages to the destination. Here is only indirect connection between source and destination node as in fig.4, the relay can receive message in t^{th} time slot and decoded message would be forwarded to the receiving end in $t+1^{th}$ time slot.

$y[t] = h[t]x[t]+n[t]$ (2)

y[t] - received message by the relay in time slot t
h[t] - channel gain between the source(S) and relay(R)
x[t] - transmitted message by the source
n[t] - noise accompanied with the message.
$y[t+1] = h[t+1]x[t+1]+n[t+1]$ (3)
where
y [t+1] - received message in time slot t+1 by the destination (D) node
h[t+1] - channel gain between the destination and relay
x [t+1] - decoded message which is forwarded by the relay to the destination
n [t+1] - noise with the decoded message.

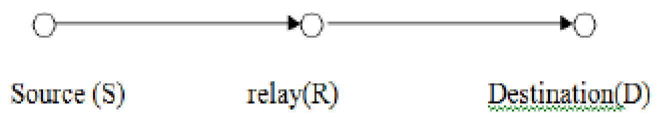

Fig4. Half duplex linear relay network

All ends in fig.4 operate only in half duplex mode or simplex mode [3],[4]. The drawback of this technique was spectral efficiency loss due to the continuous relay transmission. To avoid this, the bidirectional communication between the terminals could be used as shown in fig.5. In this technique, power requirement is more for the forward direction from T1 to T2 ,meanwhile power requirement is less for the reverse direction from T2 to T1.

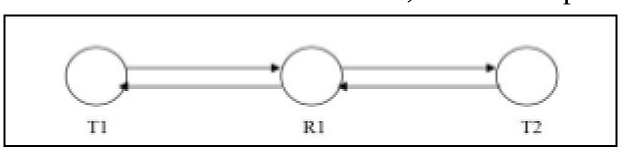

Fig5. Two-Way Relaying network

B. Amplify & forward (AF)

AF is also the simplest relaying technique. In the first (t^{th}) slot, information transmits from T1 to T2 via R1. The received information from T1 terminal along with noise will be amplified by the relay terminal R1, then the scaled information is forwarded to the terminal T2 in the another (t+1) th slot. The signal received by the intermediate terminal in the tth time slot is given by
$y[t] = x[t]\, h[t] + n[t]$ (4)
where
y[t]- received message by the relay in time slot t
h[t] - channel gain between the S and R
x[t] - transmitted message by the source
n[t] - noise accompanied with the message.
$y[t+1] = h[t+1]\, g[t]h[t]x[t]+h[t+1]g[t]n[t]+n[t+1]$(5)
where
y[t+1] - received message in t+1 time slot by the destination (D)terminal

h[t+1] - channel gain between destination and relay
x[t] - scaled information forwarded by the relay to the destination
n[t] - noise with the transmitted information
n[t+1] - noise with the amplified information.

All terminals in fig.4 operate in half duplex methodology. The drawback of this technique was a low spectral efficiency because of the continuous relay transmission. The relay in Fig.5 can operate in full duplex mode or bidirectional mode. Since there is indirect connection, all information should pass only through the relay node R1. From [16], the DF performed good for strong or weak inter relay channels, but AF scheme performed good only for weak to moderate inter relay channels not for strong relay channels.

TABLE II. COMPARISON OF VARIOUS RELAYING PERFORMANCES

S. No	Type of relaying	Type of channel used	Type of combiner/receiver used	Merits	Demerits
1	SDFR relaying	AWGN channel	Maximum Ratio Combiner (MRC)	Achieved good performance in terms of error probability & spectral efficiency	No. of relays are more
2	Hybrid DF/CF-PASS	Quasi Static fading channel	-	Optimal power allocation achieved	Loss in spectral efficiency.
3	DNF-TPSR	Rayleigh fading channel	-	Improved gain, Spectral Efficiency and diversity gain	Residual self-interference is more.
4	STBC-NOMA	Independent Rayleigh fading channel	MRC-SIC	Improved Spectral Efficiency. Increased system reliability Less complexity	High power consumption
5	HDAF-NOMA	Quasi static independent & identically distributed Rayleigh fading channel	SIC decode relay	Improved system Capacity and larger average system throughput	Wastage in SE due to half duplex relaying High power and energy consumption.
6	DF relaying	Rayleigh fading channel	Switch and Examine combiner	Achieved full diversity order & reduced computational complexity	Noise propagation is more
7	Type-II relay with DF	Rayleigh fading, channel	TSWLS Combiner	Reduced symbol error rate and improved system capacity	Energy efficiency was not concentrated.

TABLE III. COMPARISON OF DIFFERENT COOPERATIVE TECHNIQUES WITH RESPECT TO ITS OUTAGE PROBABILITY

S. No	Cooperative techniques	SNR (min)	SNR (max)	Outage probability (min)	Outage probability(max)
1	Two-path relay	2	24	10^{0}	$\sim 10^{-2}$

	with Conventional DF				
2	Two-path relay with Conventional AF	2	24	10^0	$\sim10^{-2}$
3	Two path with SIC	2	24	10^0	$\sim10^{-3}$
4	STBC-NOMA	0	30	10^0	$\sim10^{-6}$
5	D2D NOMA	0	20	$10^0\sim10^{-1}$	10^{-2}
6	D2D AMA	0	20	10^{-1}	0

V.CONCLUSION

Table II provides the comparison of various relaying protocol performances. Also Table III compares the SNR and outage probability of different techniques. We studied the half duplex relay protocols such as DF relaying protocol and AF relaying protocol. In the above said protocol it is not possible to achieve maximum spectral efficiency. To avoid wastage in SE, we can use the other type of relaying technique such as two way relaying scheme. Relaying and FD schemes can combine together to attain higher data rates. Most previous developed works are focussed on D relaying and there would be only few works on Two Way Full Duplex (TWFD) relaying scheme. Due to one way transmission, the signal could come across the major drawback of wastage in spectral efficiency. But, TWFD relaying provides efficient usage of spectral efficiency compared to conventional one way relaying using either superposition coding or network coding at relay nodes. This scheme has not been considered in the previous works. In future, further we may include two-path relaying scheme where more number of relays may implemented between source and destination to analyse the optimal relay selection among the number of relays. This survey has been done to identify the best relaying strategy for cooperative
communication.

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