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Implementation of Physical-Layer Network Coding in Two Way Relay Networks: A Survey

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Abstract— **In many wireless communication networks, network coding plays very important role. This paper studies the performance of physical-layer network coding (PNC) methods for two-way relay channels. Network coding, to enhance the throughput of two-way relay networks. Consider a network comprising of two source nodes and a single relay node, which utilizes aid communication between the two source nodes. For this situation, we study transmission over two, three or four time slots. Prior to demodulation and channel decoding, the relay nodes combine the received signals from two source nodes. The computational complexity and BER performance of the projected method are examined compared with the previous methods. Analysis demonstrates that the projected method can save 50% computational cost of demodulation and channel decoding processes compared with NC method. Hence because of this, there is an increase the power efficiency of the relay nodes in two-way relay networks.**

***Index Terms*—Physical layer implementation, network coding, two-way relay networks.**

I. INTRODUCTION

Network Coding (NC) is a procedure which is utilized to enhance the throughput execution for correspondence systems and it works in the system layer. In this innovation, the transfer hubs store and forward as well as procedure the information. On account of this handling the limit of information stream is expanded. Because of broadcasting highlight of wireless medium, Network coding is extremely reasonable to be utilized as a part of wireless systems. A typical illustration is two-way relay systems [6].

Correspondence of two source hubs can likewise done more than two time spaces, where in the first run through opening, source *A* and *B* transmit at same time to the relay, though in the second time space, the transfer enhances and advances the got signs to both sources. Such a strategy is called to as a two time space physical-layer Network coding (PNC) technique and it can achieve higher most extreme aggregate rates than the four time opening transmission technique, because of less time spaces that are utilized for transmission.

Our work in this paper describes the survey of different network coding methodologies used to analyze the throughput and bit error rate (BER) performance of PPNC. This paper is organized as follows: in section II literature survey is provided, in section III the Two-Way Relay Channels. Lastly, conclusion is given in section IV.

II. LITERATURE SURVEY

1. R. Ahlswede, N. Cai, S.-Y. R. Li, and R. W. Yeung, "Network information flow," *IEEE Trans. Information Theory*, vol. 46, pp. 1204- 1216, Jul. 2000

In this paper, Ahlswede presented another class of issues called system data stream which is enlivened by PC system applications. Consider a point-to-point correspondence system on which various data sources are to be multi-thrown to specific arrangements of destinations. We accept that the data sources are commonly autonomous. The issue is to portray the acceptable coding rate area. This model subsumes all beforehand concentrated on models along the same line. In this paper, we concentrate on the issue with one data source, and we have acquired a basic portrayal of the permissible coding rate area. Our outcome can be viewed as the Max-stream Min-cut Theorem for system data stream. As opposed to one's instinct, our work uncovers that it is by and large not ideal to respect the data to be multicast as a "liquid" which can basically be steered or recreated. Or maybe, by utilizing coding at the hubs, which we allude to as Network coding, data transfer capacity can as a rule be spared. This finding may have significant impact on future design of switching systems.

2. S.-Y. R. Li,, R. W. Yeung, and N.Cai, "Linear network coding," *IEEE Trans. Information Theory*, vol. 49, pp. 371-381, Feb. 2003

In this paper, Network coding is a promising speculation of steering which permits a hub to produce yield messages by encoding its recieved messages. An ordinary situation where Network coding offers one of a kind points of interest is a multicast system where a source hub creates messages and various recipients gather the messages. In a multicast system, straight system codes are favored because of its adequacy and effortlessness. In this paper, author introduces a way to deal with changing the straight coding issue into a diagram hypothesis issue. By using hyper diagrams, we display the

direct codes by developing a pseudo double chart of the multicast system. At that point, a legitimate straight code is identical to a spread in the pseudo double chart fulfilling a few limitations. By iterative refinements, a qualified spread can be found in polynomial time. Additionally, we propose a few preprocessing calculations to encourage diminish the calculation time required by the iterative refinements by lessening the chart size before change. An essential commitment of this work is that the proposed methodology can be promptly reached out to take care of numerous insignificant Network coding issues. By appointing diverse weights to edges, insignificant Network coding issues are diminished to the most brief way issue in the pseudo double diagram.

3.E. Fasolo, M. Rossi, J. Widmer, and M. Zorzi, "A proactive network coding strategy for pervasive wireless networking," ***Proc. IEEE GLOBECOM*****, pp. 5271-5276, Nov. 2007**

In recent years, Network coding has ended up being an effective device to spread information through a system. Various down to earth strategies have been proposed to execute Network coding additionally in wireless situations. A large portion of them depend on receptive and probabilistic arbitrary Network coding and their viability has been researched under the supposition of admired system conditions. Nonetheless, late work has demonstrated that the advantages of such systems diminish when connected in reasonable system situations. In this paper, we propose a calculation to productively scatter information through Network coding in practical wireless systems by utilizing a proactive methodology, named ProNC. We build up a dispersed and self-versatile convention which significantly expands the execution of Network coding in down to earth situations and accomplishes full unwavering quality with both low convention overhead and low postpone.

4. S. Katti, H. Rahul, W. Hu, D. Katabi, M. Médard, and J. Crowcroft, "XORs in the air: practical wireless network coding," ***IEEE/ACM Trans. Networking*****, vol. 16, pp. 497-510, Jun. 2008.**

This paper proposes COPE, another engineering for wireless cross section systems. Notwithstanding sending parcels, switches blend (i.e., code) bundles from various sources to expand the data substance of every transmission. We demonstrate that astutely blending parcels expands system throughput.

Our configuration is established in the hypothesis of Network coding. Earlier work on Network coding is primarily hypothetical and spotlights on multicast activity. This paper intends to extension hypothesis with practice; it addresses the regular instance of unicast movement, dynamic and possibly bursty streams, and functional issues confronting the joining of Network coding in the present system stack. We assess our configuration on a 20-hub wireless system, and talk about the consequences of the initially tried organization of wireless Network coding. The outcomes demonstrate that utilizing COPE at the sending layer, without changing steering and higher layers, expands system throughput. The additions shift from a couple percent to a few folds relying upon the movement design, clog level, and transport convention.

5. Z. Li and B. Li, "Improving throughput in multi-hop wireless networks," ***IEEE Trans. Vehicular Technology*****, vol. 55, pp. 762-773, May 2006**

In this paper, we examine the asset streamlining issue in MIMO multi-bounce wireless systems to augment throughput with given asset imperatives. We propose calculations with low multifaceted nature to accomplish most extreme limit. The fundamental thought is to decide the rank of the ideal transmit covariance framework and the ideal force designation of every hub independently utilizing our low-multifaceted nature calculation. Furthermore, we lessen the multifaceted nature of our calculation by including another preprocessing calculation. Utilizing our calculations, we find that while dynamical allotment of time and power could build channel limit, break even with time and power distribution among various hubs may not bring about much limit misfortune. Numerical results affirm our finding.

6. P. Larsson, N. Johansson, and K.-E. Sunell, "Coded Bi-directional relaying," ***Proc. IEEE VTC*****, vol. 2, pp. 851-855, May 2006**

Author explores balance techniques streamlined for two-way wireless transferring frameworks, for which Network coding is utilized at the physical layer. We consider Network coding in light of denoise-and-forward (DNF) convention, which comprises of two phases: numerous entrance (MA) stage, where two terminals transmit at the same time towards a relay, and communicate (BC) organize, where the transfer transmits towards the both terminals. We present a configuration guideline of tweak and Network coding, considering the superposed groups of stars amid the MA stage. For the instance of QPSK tweaks at the MA stage, we demonstrate that QPSK heavenly bodies with an elite or (XOR) Network coding don't generally offer the best transmission for the BC organize, and that there are a few divert conditions in which unusual 5-ary groups of stars lead to a superior throughput execution. Using circle pressing, we improve the star grouping for such a sporadic Network coding. We encourage talk about the configuration issue of the adjustment for the situation when the relay adventures differing qualities gatherings, for example, numerous radio wire differences and way assorted qualities in recurrence particular blurring. Execution assessments affirm that the proposed strategy can fundamentally enhance end-to-end throughput for two-way transferring frameworks.

7. P. Popovski and H. Yomo, "Physical network coding in two-way wireless relay channels," ***Proc. IEEE ICC*****, pp. 707-712, Jun. 2007**

Author researches direct identification and precoding for denoising-based physical Network coding (D-PNC) in two-way multi-information multi-yield transfer channels. We propose a MMSE-based locator, which first gives a coarse identification to the two source messages utilizing MMSE indicator and after that identifies the result of the two coarse recognized messages. The upside of such finder is to randomize the obstruction. A basic precoder is likewise proposed for transfer message transmission, which gives decency. Reproduction results demonstrate that D-PNC with the proposed locator and precoder has comparable pair blunder rate execution to different strategies while keeps straightforward structure and lower many-sided quality.

8. S. Zhang and S.-C. Liew, "Channel coding and decoding in a relay system operated with physical-layer network coding," *IEEE JSAC*, vol. 27, pp. 788-796, Jun. 2009

This paper explores join by-connection channel-coded PNC (physical layer Network coding), in which a basic procedure at the transfer is to change the superimposed channel-coded parcels got from the two end hubs (in addition to commotion), Y3 = X1+ X2+W3, to the system coded blend of the source bundles, S1⊕ S2. This is rather than the customary various access issue, in which the objective is to get both S1 and S2 expressly at the relay hub. Attempting to get S1 and S2 unequivocally is needless excess in the event that we are just inspired by S1oplusS2. In this paper, we allude to the change Y3 = S1 ⊕ S2 as the channel-interpreting Network coding process (CNC) in that it includes both channel disentangling and arrange coding operations. This paper demonstrates that on the off chance that we receive the rehash gather (RA) channel code at the two end hubs, then there is a perfect decoder at the transfer that can play out the change Y3 = S1 ⊕ S2 effectively. In particular, we upgrade the conviction spread interpreting calculation of the RA code for conventional point-to-point channel to suit the need of the PNC numerous entrance channel. Results demonstrate that our new strategy outflanks the beforehand proposed strategies fundamentally as far as BER without included unpredictability.

9.S. Katti, S. Gollakota, and D. Katabi, "Embracing wireless interference: analog network coding," *Proc. ACM SIGCOMM*, pp. 397-408, Aug. 2007.,"

Wireless systems endeavor to abstain from booking different transmissions in the meantime with a specific end goal to avert obstruction. This paper receives the inverse methodology; it urges deliberately picked senders to meddle. Rather than sending parcels, switches forward the meddling signs. The destination influences system level data to cross out the impedance and recuperate the sign bound to it. The outcome is simple Network coding since it blends signals not bits. All in all, consider the possibility that wireless switches forward signs rather than bundles.

Hypothetically, such a methodology pairs the limit of the authoritative 2-way transfer system. Shockingly, it is likewise viable. We execute our configuration utilizing programming radios and demonstrate that it accomplishes essentially higher throughput than both conventional wireless directing and earlier work on wireless Network coding.

10. S. Zhang, Y. Zhu, S.-C. Liew, and B. L. Khaled, "Joint design of network coding and channel decoding for wireless networks," *Proc. IEEE WCNC*, pp. 780-785, Mar. 2007. 675

Network coding has been accepting much consideration as of late for its capacity to enhance system throughput and upgrade system vigor. In this paper, we explore the outline of Network coding in wireless systems and propose a joined low many-sided quality Network coding and channel translating technique. We break down the limit of the proposed technique for both the twofold symmetric channel (BSC) and AWGN channel and demonstrate that it can accomplish practically the same channel limit as customary Network coding with a little corruption in the framework bit error rate (BER) execution while accomplishing very nearly half many-sided quality decrease. It is likewise demonstrated that the proposed Network coding configuration can be connected in wireless helpful systems.

III. THE 2-WAY RELAY CHANNELS

Wireless relaying is recognized as a accomplished method to grow the scope of wireless systems. In wireless area, the relay goes about as the "intermediary "for information trade encompassed by various clients. The 2-way transfer channel (2-WRC) is viewed as an established representation of wireless relay system and has been researched generally as of late. The start of 2-WRC can be followed to Shannon's spearheading work in [9], i.e., the 2-way channel (2-WC) without relay was explored.

The 2-WRC can be dealt with as a mix of 2-WC and relay system. The 2-WRC is a three-hub direct system in which two clients A and B need to trade their information through a transfer hub R. The uplink of 2-WRC, i.e., the connections from the two clients to the transfer, can be seen as a multiple access channel (MAC) while the downlink, i.e., the connections from the relay to the two clients, can be seen as a board caste channel (BC). All hubs work into equal parts duplex mode and an immediate connection between the two clients is occupied. Like different sorts of relay system, the customary intensify and-forward (AF) and interpret and-forward (DF) techniques can be executed in the 2-WRC [5].

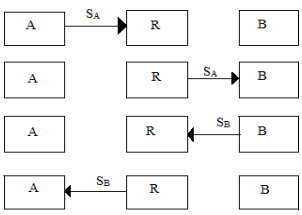

Figure 1: (a) Conventional TDMA

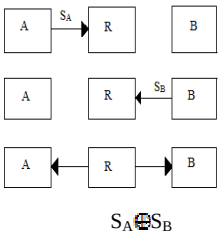

Figure 1: (b) Standard NC

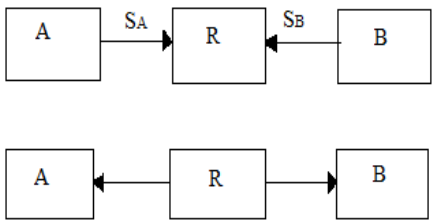

Figure 1: (c) PNC

A customary bi-directional information trade convention is TDMA (Time Division Multiple Access), as appeared in Fig. 1(a). In this convention, every client on the other hand transmits their sign to the transfer which maintains a strategic distance from the co-channel impedance. Be that as it may, this devours four orthogonal time spaces and thus gives up ghastly proficiency. As another methodology, standard Network coding, as appeared in Fig.1(b), permits the transfer to produce the XOR blend (viewed as the system coded information) of the information from the two clients and forward to them.

Two clients then concentrate the sought information by utilizing the XOR operation on the got system coded information and their side-data. In any case, the standard NC still requires three transmission stages as every client transmits information to the transfer utilizing diverse time-spaces.

By completely using the superposition way of electromagnetic waves, PNC in [1, 5] permits two clients all the while to transmit their signs to the relay in the MAC stage, as appeared in Fig. 1(c). The relay specifically maps the superimposed sign into the XOR mix of information from the two clients, which is alluded to as the system coded image. At that point in the BC stage, the subsequent system coded image is sent to the clients. PNC gives a huge change as far as the ghastly productivity over the TDMA and standard NC convention as it just expends two transmission time slots."It is anything but difficult to realize that the computational many-sided quality of PPNC is nearly the same as PNC as and not as much as NC. Because the accompanying strategy is the same as PNC, we characterize it as pseudo physical-layer Network coding.

IV. CONCLUSION

More importantly, we note that PPNC can adopt most of the previous research results of PNC. However, the facts we cannot ignore: (i) the two time's noise power will lead to about 3 dB penalty to system performance and (ii) PPNC method is also a 3 time slots method.

Here the discourse of execution of the current system coding methods are conveyed .By correlating the performance between NC method and PPNC method considered for comparison and are utilized as two ways relay communication, these procedure leads to the conclusion that computational complexity of node R can spare half of demodulation and channel decoding forms with around 3dB penalty of BER execution. The signal to noise ratio v/s bit error rate variation. It can also be cleared that the reduction in bit error rate with respective to signal to noise ratio increment is significantly more, in PPNC method. When compared to other method (NC).Also PPNC performs better in terms of the parameters such as high power efficiency and throughput.

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