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THROUGHPUT PERFORMANCE IMPROVEMENT FOR UNBALANCED SLOTTED ALOHA RELAY NETWORKS USING HYBRID NETWORK CODING

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Abstract - *To investigate the throughput performance of the network coding (NC) schemes under the slotted ALOHA protocol is mentioned. All-inclusive- interfering unbalanced network in which two client groups with different numbers of nodes communicate with each other through a relay node. This approach derives the closed-form expressions of the network throughput un- der the physical-layer network coding (PNC), traditional high layer network coding (HNC), and non-network-coding (NNC), respectively. This method also shows the necessary and sufficient condition to make the relay node unsaturated. From the analytical results, and find that although PNC has better transmission efficiency in the two-way relay channel (TWRC); it does not always have better network throughput when the network has multiple client nodes. Then for further improve the network throughput, the approach propose the hybrid NC scheme, which allows the relay node to turn it HNC scheme if it fails to explore the PNC transmission.*

This method further obtains the closed-form expression of the network throughput and the necessary and sufficient condition to make the relay node unsaturated in the hybrid NC scheme. Simulation results show that the hybrid NC scheme has better throughput performance than the PNC, HNC, and NNC schemes. Moreover, the approach optimizes the network throughput of the hybrid NC scheme in terms of the transmission probability of the re- lay node. At the last, evaluate the throughput performance of hybrid NC scheme through simulations.

Key Words: Slotted Aloha, Relay Network, PNC, HNC, Network Coding, etc.…

1. INTRODUCTION

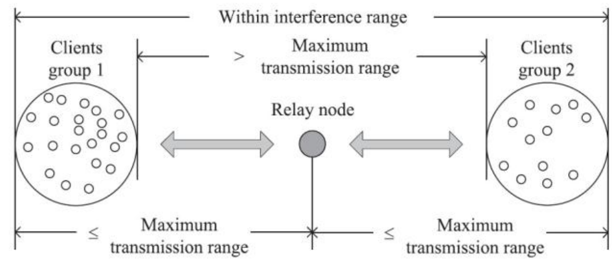
Network coding (NC) has been proposed as a promising technique to improve the throughput of wireless network.

Traditionally, NC operation is performed at the network layer, and three time slots are needed for two client nodes to exchange two packets through a relay node. This approach refers to this three-time-slot network coding scheme as high-layer network coding (HNC) scheme.

The physical-layer network coding (PNC) further explores the superimposed Electro-Magnetic (EM) waves as a natural way of network coding operation.

In PNC scheme, only two time slots are needed for two client nodes to exchange two packets through a relay node, which significantly improves the network throughput.

1.1 Unbalanced relay network



1.2 Currently Existing Technologies:

Currently there are very few accepted technologies, tools for carrying out the work of image inpainting. The work is still in the beginning stage and a lot of researches are being carried out to explore this area.

Due to the lack of such software's, the restorers manually do the work of image inpainting as in museums etc. A notable library for carrying out image inpainting is under development and is hosted as an open source project at sourceforge.net by the name of "restoreInpaint". It is aimed at making 8 or 16 bit depth images better. It provides several algorithms including detection algorithms (which covers the problem of finding target areas), Inpainting (discovers the problem of filling detected cracks and missing thin parts of the images, paintings and frescos), Restoration (deals with removing noise etc.) along with several other algorithms. It is implemented in C++.

Software that deals with the solution of this problem is titled "Photo Wipe" by "Hanov Solutions". It provides tools for selecting the region to be inpainted and then applies some algorithm to achieve the desired result.

2. LITERATURE SURVEY

In the literature, the study of PNC is mostly focused on the physical layer, and based on the two-way relay channel (TWRC), where two client nodes exchange packets through a relay node.

When PNC is applied to a general wireless network, the MAC protocol needs to be adjusted. In two 802.11-like distributed MAC protocols were proposed to support PNC transmission. The authors proposed the multi-user PNC method for slotted ALOHA network. However, do not provide analytical network throughput performance on the proposed MAC protocol with PNC. Recently, the authors in analyzed the throughput performance of PNC coordinated with an 802.11-like protocol in a simple balanced network in which all the client nodes have the same contention window size and transmission probability.

The throughput performance of slotted ALOHA network with HNC scheme was investigated in analyzed the performance of HNC in a multi-hop multicast slotted ALOHA network with game theoretic approach., Amerimehr et al. proposed a multi-class queuing model to analyze the maximum stable throughput of HNC in a slotted ALOHA wireless tandem network.

The optimized the transmission probabilities subject to flow conservation and rate constraints in an HNC slotted-ALOHA multi hop wireless network. The authors investigated the throughput gain of HNC versus non-network-coding (NNC) in a slotted ALOHA network with star topology. However, it is assumed that all the client nodes have the same transmission probability. Two recent papers, analyzed the throughput performance of the NNC and HNC schemes in an unbalanced slotted ALOHA network with one relay node and two client groups. However, the authors assumed that the two client groups are far apart such that the client nodes within different groups do not interfere with each other. In this paper, author investigate the throughput performance of network coding schemes (both HNC and PNC) under the slotted ALOHA protocol in the relay system where two client groups communicate with each other through a relay node.

Author considers the unbalanced network, where the two groups have different numbers of nodes with different transmission probabilities. Furthermore, author considers the all-inclusive-interfering case where all the nodes in the network interfere with each other.

This is because:

1) The unbalanced network is more practical and general. As in a wireless network, the number of client nodes in the two groups may not always be the same, and assigning the same transmission probability to all the nodes may not maximize the network throughput.

The balanced network can be treated as a special case of unbalanced network.

2) In practice, the interference range is usually larger than the transmission range. The two client groups, which both are in the transmission range of the relay node, are highly likely to interfere with each other. However, both the modeling and the theoretical analysis of the all-inclusive-interfering unbalanced network are more complicated.

Author obtain the closed-form expressions of the network throughput of the PNC, HNC, and NNC schemes under the slotted ALOHA protocol in the all-inclusive-interfering unbalanced relay network.

Author further show the necessary and sufficient condition to ensure the relay node is unsaturated. Author disaffected by the balance of the total traffic between the two client groups; while the throughput performance of PNC is heavily affected by the value of Î±, which represents the probability that a transmitted NC packet contains the information of two packets.

Thus, PNC may have lower throughput than HNC when Î± is small. This motivates us to further propose the hybrid NC scheme, which allows the relay node to turn to HNC scheme if it fails to explore the PNC transmission. We provide theoretical analysis on the throughput performance of hybrid NC scheme together with the necessary and sufficient condition to ensure the relay node is unsaturated.

The hybrid NC scheme has better throughput performance than single HNC or PNC scheme. Author further optimize the network throughput of the hybrid NC scheme in terms of the transmission probability of the relay node hr.

In particular, author shows that the network throughput of hybrid NC scheme monotonically decreases with hr. Therefore, the optimal hr is the minimum value that ensures all the buffers at the relay node are unsaturated. Simulation results show that the throughput gain of hybrid NC and that the throughput performance of HNC is mainly scheme versus PNC, HNC, and NNC schemes can respectively reach 127.7%, 154.7%, and 188.9%. The rest of this paper is organized as follows. Section II presents the network model and the transmission processes of the NNC, HNC and PNC schemes with the slotted ALOHA protocol.

Author derives the closed-form expressions of the network throughput for NNC, HNC, and PNC schemes. Author proposes the hybrid NC scheme, derive the closed-form expression of the network throughput, and optimize the network throughput of hybrid NC scheme. Author carry out extensive simulations to validate our model, discuss the relationship between the network throughput of hybrid NC scheme and system parameters, and compare the throughput of the NNC, HNC, PNC, and hybrid NC schemes.

3. SYSTEM DESIGN OVERVIEW:

3.1 Problem Statement:

Using Hybrid Network coding scheme, we improve the throughput performance of network coding schemes (both HNC and PNC) under the slotted ALOHA protocol in the relay system where two client groups communicate with each other.

Our aim is to evaluate the throughput performance of hybrid NC scheme through simulation.

The proposed System contain the advantage of PNC (physical network coding) and HNC (High layer Network Coding), NC (Hybrid Network Coding) resp.

By using these methods as per the requirement we can improve the throughput performance of the hybrid unbalanced slotted ALOHA protocol.

3.2 Objective and scope:

Main objective is to investigate the throughput performance of network coding schemes (both HNC and PNC) under the slotted ALOHA protocol in the relay system where two client groups communicate with each other. 1) To design framework for Hybrid Unbalanced Slotted ALOHA protocol which contains?

- Network model of PNC, HNC, slotted ALOHA.
- Transmission process in HNC, PNC.
- Throughput calculation of hybrid NC Schema.

2) To optimize the network throughput.

3) To evaluate the performance of proposed scheme through simulation.

4) To show that the proposed scheme has better performance than the exiting scheme.

Scope:

Proposed approach is used to communicate two client groups under the slotted ALOHA protocol.

4. METHODOLOGY:

4.1 Network Model:

Consider a bidirectional unbalanced relay network with two client groups of u1 and u2 nodes, as shown in transmission process in NNC scheme. Relay node is within the transmission range of all the client nodes.

The nodes in different groups are within the interference range but out of the transmission range of each other. Thus, two nodes in different groups can only exchange packets through the relay node.

The relay node does not generate traffic, and there is no traffic within the same client group. Assume the saturated traffic load such that each client node always has packets to send.

There is only one physical channel, and all the nodes contend for the channel according to the slotted ALOHA protocol. Assume half-duplex transmission such that a node cannot transmit and receive simultaneously.

4.2 The NNC, HNC and PNC Transmissions Coordinated With Slotted ALOHA Protocol:

In the slotted ALOHA protocol, time is divided into a number of slots. Each packet transmission starts at the beginning of a time slot. To reduce mutual collisions, each node initiates a transmission with a given probability when it has packets to transmit.
Assume that the transmission probability is the same for the nodes in the same group but different for the nodes in different groups. If only one node initiates a transmission in the current time slot, its destination node can successful receive the packet. Otherwise, collision occurs, and the transmission in the current time slot is failed.

Next this approach show the transmission processes in NNC, HNC and PNC schemes during a time slot, respectively. Note that since the overhead in each scheme is different, the slot time of each scheme is also different.

In NNC scheme, the successful transmission process from node ni to nj is s. At the beginning of the timeslot, ni transmits a packet to n j .time, and then sends back an acknowledgement (ACK) packet to ni.

The slot time Tslot in NNC scheme can be calculated as follows:

Tslot= T packet+ TACK + SIFS + 2max ……………. (4.1)

Where Tpacket, TACK, and Î´max are the time used for transmitting the data packet, the time used for transmitting the ACK packet, and the maximum propagation delay, respectively.

In HNC scheme, the client node in each group transmits a packet to the relay node with the same process in NNC scheme, When a client node transmits, all the other client nodes in the same group perform opportunistic listening (receive the transmitted packet and store it in their temporary buffers).

The transmitting client node also stores the transmitted packet in its temporary buffer. By doing so, the client nodes can decode all the NC packets from the relay node in the second step. After receiving both packets from two client groups, the relay node forms an NC packet, and then broadcasts it to the two destination nodes at the beginning of the next time slot. Then, the two destination nodes respectively transmit an ACK packet to the relay node after a delay of

SIFS and 2SIFS + TACK + max ……………. (4.2)

If the relay node has a packet from only one client group, it transmits the packet to the destination.

Tslot= Tpacket+ 2TACK + 2SIFS + 3max ……………. (4.3)

In PNC scheme, When two nodes in different groups concurrently transmit a packet to the relay node, Request to Send (RTS)/Clear to Send (CTS) mechanism is adopted to coordinate the transmissions.

Considering that the propagation delay1. Since the propagation delay could be different for different transmissions, the slot time should is set according to the maximum propagation delay, between the relay node and the client nodes may be different.

This approach uses the similar synchronization method proposed in to make two packets from two client nodes in different groups can reach the relay node simultaneously. In practice, some technologies can be used to relax the synchronization requirement.

For example, when Orthogonal Frequency Division Multiplexing (OFDM) technology is used, the relay node can successfully extract an NC packet from the superimposed EM wave if the difference of the arrival times is within the cyclic prefix (CP) of the OFDM system. The detailed transmission processes of PNC scheme. First, at the beginning of the time slot, a client node ends an RTS packet to the relay node with the information indicating its destination client node (i.e. nj) in the other group.

After correctly receiving the RTS packet, the relay node first waits for an SIFS delay, and then broadcasts a CTS packet with a time stamp containing the transmit instant to both ni and n j .

When ni and nj receive the CTS packet, they can respectively calculate the propagation delay between the relay node and themselves, Î´i and Î´j, by subtracting the time stamp in the CTS from the receiving time. Here, we assume that all the nodes have a common time reference, which can be obtained from the Global Positioning System (GPS).

Then, ni and nj send a packet to the relay node with a delay of

SIFS + 2Î´max â˘2Î´ j and SIFS + 2Î´max â˘2Î´ j , respectively. ……………. (4.4)

In the case that n j does not have a packet for ni, it sends a dummy packet instead. Therefore, the relay node can receive the two packets simultaneously at the time â€œ the CTS time stamp + SIFS + 2Î´maxâ€, and extract an NC packet. The relay node then broadcasts an ACK packet to both ni and n j after an SIFS delay for confirmation.

When a client node successfully transmits a packet, it stores the transmitted packet in its temporary buffer to make.

At the beginning of the time slot, the relay node broadcasts an NC packet to ni and nj. After receiving the NC packet, ni and nj send back an ACK packet respectively after a delay of

SIFS + 2Î´max â˘2Î´i and SIFS + 2Î´max â˘2Î´ j …….. (4.5)

Since the two ACK packets will arrive at the relay node simultaneously, the relay node can check the overlapped ACK packet and know whether the NC packet is correctly received or not.

slot time Tslot in PNC scheme equals

Tslot= TRT S + TCT S + Tpacket+ TACK + 3SIFS + 4Î´max ……………. (4.6)

Approach proposes the hybrid NC scheme, in which the relay node turns to the HNC scheme if it fails to explore the PNC transmission. As will be seen later, the hybrid NC scheme can further improve the network throughput.

In hybrid NC scheme, the successful transmission process from the client nodes to the relay node is as follows. At the beginning of a time slot, client node ni sends an RTS packet to the relay node with the information indicating its destination node n j in the other client group

$$D(P) = \frac{|\Delta Ip.Np|}{255} \quad \text{…………….} \ (4.7)$$

5. EXPERIMENTS EXECUTION AND RESULTS:

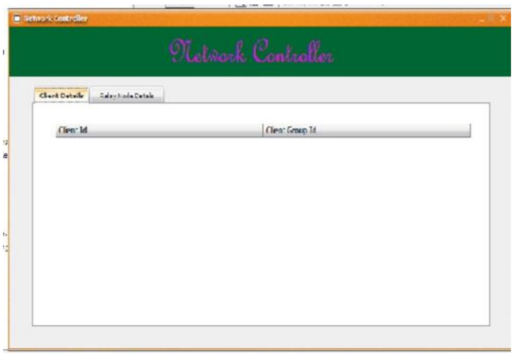


Fig -1: Network Controller

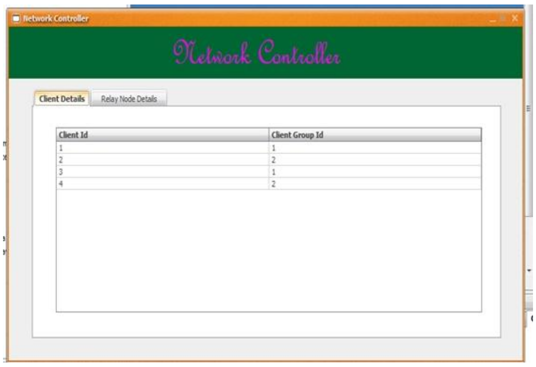


Fig -2: Network Controller with Client details

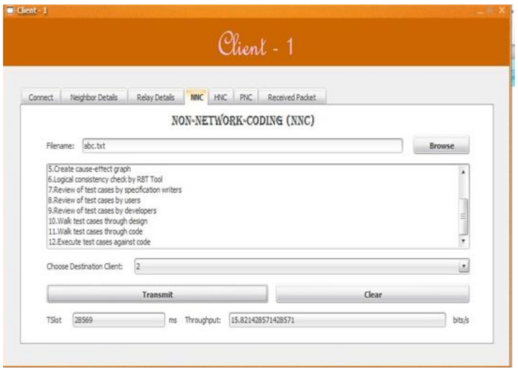


Fig -3: Client 1 Uploaded file and ready to Transfer

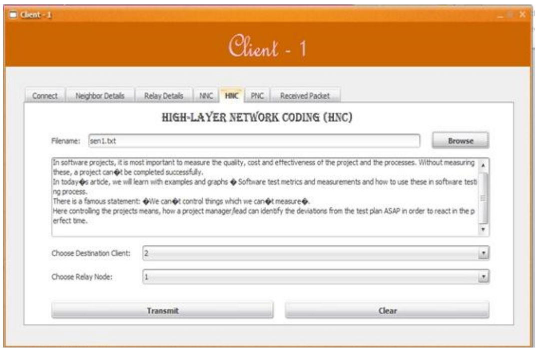


Fig -4: Client 1 in HNC

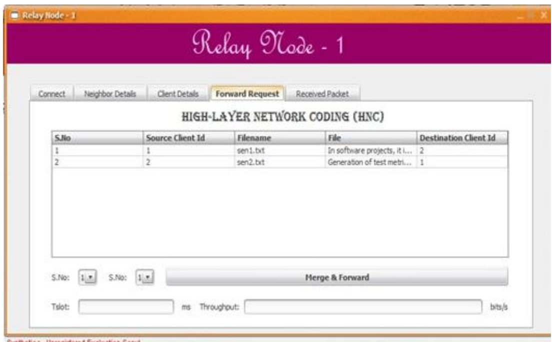


Fig -5: Both Files combine together in Relay node

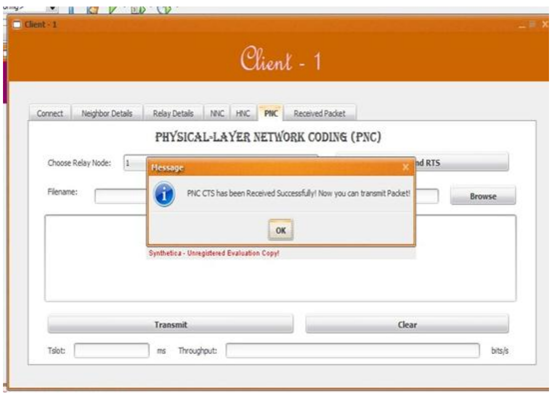


Fig -6: In PNC Schema: CTS Message has been Received Successfully

6. CONCLUSIONS

This approach studied the throughput performance of the network coding schemes in the unbalanced slotted ALOHA network. In particular, the closed-form expressions of the network throughput for the PNC, HNC, and NNC schemes, together with the corresponding necessary and sufficient condition to make the relay node unsaturated.

The throughput performance of PNC significantly deteriorates when the traffic between two client nodes in different groups is not balanced. The hybrid NC scheme that combines the advantages of PNC and HNC schemes to further improve the network throughput.

The closed form expression of network throughput for hybrid NC scheme together with the necessary and sufficient condition to make the relay node unsaturated.

Moreover, this approach optimized the network throughput of the hybrid NC scheme in terms of the transmission probability of the relay node. In addition, this is used to evaluate the throughput performance of the hybrid NC scheme with simulations.

7. ACKNOWLEDGEMENT:

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7. REFERENCES

[1] Ahlswede, S. Li and R. Yeung, "Network information flow", IEEE Trans. Inf. Theory, vol. 46, no. 4, pp. 1204-1216, Jul. 2000.

[2] S.-Y. R. Li, R. W. Yeung and N. Cai, "Linear network coding", IEEE Trans. Inf. Theory, vol. 49, no. 2, pp. 371-381, Feb. 2003.

[3] Zhang, S. C. Liew and P. P. Lam, "Hot topic: Physical-layer network coding", in Proc. ACM Mobicom, pp. 358-365, 2006.

[4] Popovski and H. Yomo, "The anti-packets can increase the achievable throughput of a wireless multi-hop network", in Proc. IEEE Int. Conf. Commun., pp. 3885-3890, 2006.

[5] Vishnu, V. Kiran and B. R. Sundar, "Physical layer network coding for two-way relaying with QAM", IEEE Trans. Wireless Commun., vol. 12, no. 10, pp. 5074-5086, Oct. 2013.