ENERGY EFFICIENT WIRELESS SENSOR NETWORK MULTIRATE SIGNAL PROCESSING FOR CHANNEL CAPACITY AND DELAY IMPROVEMENT

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Abstract
The issue of energy efficiency for processing multirate signal for wireless sensor network with the aim of increasing channel capacity and delay improvement is addressed. Different types of coding and modulation techniques are used to choose devices from different transmission rates. In a multichannel network the selection of link rate is difficult. In this paper we tried to focus on solution of link rate problems by network coding and delay improvement. The network efficiency can be improved by specific reuse (SR).We further focus on the combined effect of network coding and link rate distribution in Multirate signal processing for WSN. We also present a comparison between the throughput when network coding and distribution of link rate (LR) is applied and when it is not applied to network.

Keywords: **Multirate, Specific reuse (SR), Distribution link rate (DLR),**

I. INTRODUCTION

Wireless World Research Forum (WWRF) helps to connect the devices in the network. The diversity of the devices and services will increase. For the transmission of video signal a high data rate is required and now days it is necessary to have higher data rate. Three important factors required for good realization are cost, energy and bandwidth among these three factors energy efficiency is one of the most important factor for battery operation and device operation. So it is necessary to concentrate on bandwidth and the data rates. It is also required to give emphasis on energy and power efficiency of the wireless systems [1].

With the help of network coding in multi hop systems throughput can be increased. Results from the power of network coding (NC), the original demonstration of Ahlswede et al. [2], of how in-network mixing of packets by intermediate nodes helps to achieve a communication capacity [3].

For wireless communication the diversity in link-layer rate is important with network coding. In Most wireless communication the cards are now able to perform adaptive modulation so as to vary the link rate in response to the signal-to-interference levels at the receiver. If the power of transmission is same for all the links then fast transmission rate causes the small range of transmission. [4].

Wireless networks are dependent on multi-access nature of communications, interference and wireless channel time-varying characteristics. The interdependencies are generated across devices and network layers because of which the use of cross-layer design and optimization is in demand. So that we can maximize their capacity [5]

We have to gather the data In wireless sensor networks from the nodes. The gathering of data from nodes is one of the difficult tasks. It mainly depends on the communications between sensor nodes and the sink node. Data collection suffers from the following points:

i) For long-range wireless communications the energy required for the sensor node affected due to super linear path loss exponents.

ii) For shorter range, multihop wireless communications are adopted due to the data aggregation toward the sink. The nodes around the sink still have to consume much more energy than others due to heavier volumes of traffic transmitted by them. This reduces the lifetime of network. [6]

For video signal transmission, it is very difficult to transmit the whole video stream up to the cell boundary because there is a rapid degradation of the channel throughput due to the severe inter-cell interference (ICI) over the multi-cell environment. To overcome this problem, multiple bit streams are generated with the help of scalable video coding (SVC), and it is independently delivered relying on the flow control algorithm according to the channel status. The original sequence is divided into two parts, first the base layer which is used for more important visual data and second the enhancement layer which is used for less important visual data.

II. RELATED WORK

It was demonstrated in paper [7] that the packets which are used in communication can achieve the required capacity by feasible method. The coding of packets or data increases the throughput of the network. The multicast traffic is important in wireless sensor network. The capacity of channel depends on the maximum data rate of transmitter which can send data to all sets of receiver.

The capacity can be measured by flow between (t, r) transmitter (t) and receiver(r). The capacity for multiple can be achieved with the help of network coding multicast capacity can be achieved. Li et al. [13] showed that it is sufficient for the encoding function to be linear. Due to the network coding some of the extra advantages other than throughput can be achieved. It gives the robustness. Nodes are allowed to receive more than one copy of packet. Energy efficiency can also be achieved by network coding. It can be done by shortening the number of transmission. Throughput is higher for unicast applications.

According to Katti et al. [9] stated that the network coding helps to improve the throughput of network by using network coding. It shows that linear coding in random manner for multicast wireless communication system in which he proved that with the help of linear coding in random manner the latency for sharing of file can be improved. For the calculation of maximum throughput which can be obtained for multicast wireless communication system a linear programming formulation was used in [10]. A network coding is used for this purpose. But one the disadvantage of this calculation that they have not considered the effect of rate diversity of transmission which can be observed at link layer. It was first explained by [11] about the use of link-layer transmission rate diversity for broadcast and multicast routing. This paper explained a rate-diversity aware broadcast tree construction heuristic. It is called as weighted connected dominating set. It shows that the broadcast latency is reduced by 4 times than that of normal diversity unaware case. The paper [3] proved that at transport layer the rate control is addressed to adjust source rates. Khreishah et al. [8] explained the allocation of distributed rate algorithm. Also gives the emphasis on different coding techniques. This paper gives information about transmission for multiple unicast flows. We also present an analysis on the bound on the gain of network coding and multi-rate diversity.

It is proved by Liu et al. [14] that the bounds on the gain of network coding to be a factor of 2 for the single multicast case. In the seminal paper [15] it is proved that throughput of routing based solution can be improved by network coding in which the coding is done in pair form. For this purpose the perfect scheduling is not done in spite of this correct scheduling throughput of the network can be improved. Le et al. [16] demonstrated another upper bound on the throughput gain for a general wireless network and it depends on the encoding number. Encoding number is the number of packets which can be encoded by a coding node in each transmission. For a single coding structure with n flows, the maximum throughput gain for both the coded and non-coded flows is upper bounded by $2n/(n + 1)$.

But the effect of transmission rate diversity at link layer is not considered by all these papers. It was assumed that transmission rate and link distance are independent of each other. In the wireless network where video sensors are used Video encoding technique requires to meet the special requirements of resource-limited video In distributed multi-view video coding (DMVC) system, multi-view video sources are encoded separately and decoded dependently, Because of this the calculation load is increased to decoder side. In this case the decoder will be busy as compared to encoder Side. In DMVC system the generation of information is one of the most important factors. It has a direct influence on the system performance. In this paper, a new fusion method is introduced. According to this method it combines the histogram matching and the minimum sum of the absolute differences (SAD). This method is used to generate the information. [17].The comparative study is shown in table 1

Sr. no.	Methodology	Application/advantages	Drawback	Future scope
[17]	DMVC	Burden shifted from the encoder side to the decoder side		
[6]	Multirate CSS Scheme MR-CSS scheme		Neglecting the travel of the ME on the data rate	MR-CSS scheme smaller range,
[8]	Data compression algorithm	Helps to reduce the power consumption	Require more power	requiring further investigation in WSNs
[9]	MRIC strategy	avoiding packet disorder phenomenon	Information travel through N/W at slower rate	Network capacity can be improved
[4]	Linear programming model	N/W coding and multirate diversity can improve r throughput of N/W		To develop a rate aware multicast routing protocol fully advance to take the advantage not only of rate diversity but also n/w coding.
[5]	JMR algorithm	Problem of selection link rate is solved		Transmission power of node is less

Table 1: comparative study

III. PROPOSED WORK

To understand the importance of rate diversity and network coding, We consider the example of simple network shown in fig.1 It also explains the potential gain from combination of both network coding and rate diversity. Let's assume the 5-node wireless topology in Fig. 1. The link between node 1 and 2 is 1 Mbps.The links between the other nodes are 11Mbps. Node 1 and Node 2 wants to transmit packet A and packet B respectively. In a wireless transmission, the links are not independent. Node 1 uses the same interface to simultaneously reach both nodes 3 and 4. Let us assume that each packet is of size 11 Mbits

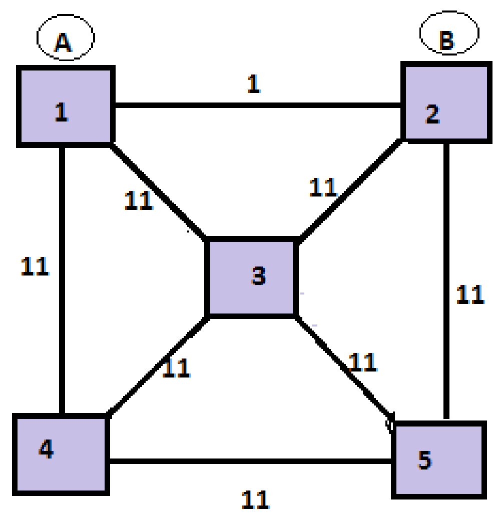


Fig.1. A multi-rate network example

Now to transmit the packets A and B from node 1 and 2 let's consider the three different case which on comparison proves that if we use network coding and rate diversity combination transmission time can be reduced.

Case1: packet transmission with Rate diversity-unaware without Network Coding

Case 2: packet transmission with Rate diversity-unaware with Network Coding

Case 3: packet transmission with rate diversity-aware with network coding.

For case 1: when node 1 is sending a packet to node 4, node 2 cannot send a packet to node 3 because node 3 is on the same interference range from communication between node 1 and 4. In fig.2 the transmission of packet A and B is shown.

Node 1 transmit packet A to node 2, 3 and 4 and time required is 11 time units.

Node 2 transmit packet B to node 1,3 and 5 and time required is 11 time units.

Node 3 transmit packet B to node 4 and time required is 1 time units.
Node 3 transmit packet A to node 5 and time required is 1 time units.
Total time is 24 time unit

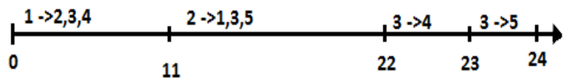


Fig.2 Transmission of packet with rate diversity-unaware without NC

For case 2: The time required can be reduced by network coding.
Node 3 sends A XOR B to node 4 and 5 single transmission.
Node 4 has A and can recover B from A XOR B.
Node 5 has B and can recover A from A XOR B.
The total time required for transmission can be reduced by 1 using network coding shown in fig.3

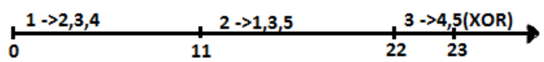


Fig.3 Transmission of packet with rate diversity-unaware with NC

For case 3: In this case different nodes adopt different rates for their transmissions. The time required will be only 4 units.
Node 1 first transmits A to 3 and 4 time 1 unit
Node 2 transmits B to 3 and time 1 unit
Node 3 transmits A to 2 and 5 at 11 Mbps, and follows up with a broadcast of packet B to 1 and 4, again at 11 Mbps.shown in fig.4

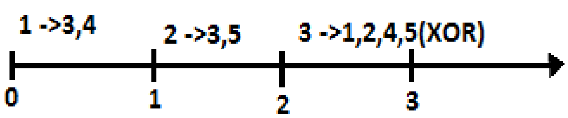


Fig.4 Transmission of packet with rate diversity-aware with NC

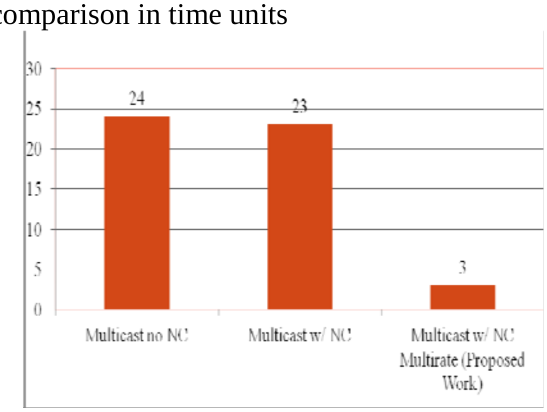
Further it can be reduced to unit 3 by combining network coding with rate diversity.
Node 1 sends the packet A to 3 and 4 using the 11 Mbps transmission rate
Node 2 sends packet B to 3 and 5 using the faster rate (11 Mbps).
Then node 3 sends (at 11 Mbps) the XOR message to 4 and 5, and also to nodes 1 and 2.
Node 1 will retrieve B by applying XOR
The tabular explanation is given in table 2.

Table 2 transmission time comparision

Route of node	Rate diversity-unaware without Network Coding	Rate diversity-unaware with Network Coding	rate diversity-aware with Network Coding
Node 1 to 2,3,4 Node 2 to 1,3,5 Node 3 to 4 Node 4 to 5	Total time – 24 unit		
Node 1 to 2,3,4 Node 2 to 1,3,5 Node 3 to 4,5(X-OR)		Total time – 23 unit	
Node 1 to 3,4 Node 2 to 3,5 Node 3 to 1,2,4,5 (X-OR)			Total time – 3 unit

IV.RESULTS

Proposed work reduces the packet transmission time to 3 units. Packet broadcasting time comparison in time units



V. CONCLUSION

In this paper We have demonstrated that network throughput can be increased by combining multi-rate link layer broadcasts and network coding We observed that NC and multi-rate can improve the network achievable rate. Also, we showed that the comparatively the time requirement can be reduced using combination. These results are important to help in the design of new protocols that exploit network coding and rate diversity. We have demonstrated in this paper that multi-rate link layer broadcasts and network coding can be mutually combined to increase network throughput in multicast applications.

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