Minimizing Burst Transmission Error in WSN by Honeycomb Optimization

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Abstract: This paper proposes scheduling methods to reduce the burst transmission errors between the wireless nodes. Transmission errors are rectified by decreasing the chances of root fading. Best afford path is proposed to handle root fading and to decrease the transmission errors. This method overcomes the problem of network misbehavior that is not addressed in CNC but concentrates in NUM. We also use honey comb algorithm to extend the CNC initiated to the source node throughout the network for other nodes depending upon the network type and thus improving the mechanism when the size of network increases; scalability.

Index Terms: Wsn, Burst transmission error, Compressive Network Coding, Honey Comb.

I. INTRODUCTION

Wireless sensor networks (WSNs) are used for many important applications in environment, habitat, and infrastructure monitoring. The main task of the sensors is to periodically generate readings and transmit them to the sink. However, sensor networks are featured with highly unreliable links, and most sensors need multi-hop relay to reach the sink. In particular, MORE has demonstrated that intra-flow coding can efficiently increase throughput. However, traditional network decoding has an unfavorable all-or-nothing effect. Suppose the source has m blocks of original data. Then, in order to recover Both factors contribute to the high loss rate of data transmission, and make it very challenging for the sink to obtain high-fidelity sensor readings under stringent energy constraint. In order to exploit the broadcast nature of wireless medium and to combat loss, network coding has been applied in wireless multi-hop networks. the original data, the destination should receive at least m linearly independent blocks. If less than m blocks are received, then almost none of the original blocks can be recovered. When the energy budget is not sufficient, the source has to decrease its sensing rate (i.e. decrease m) in order to ensure reliability. However, decreasing sensing rate may lose important information and affect data fidelity.

Compressive network coding (CNC) is to address the tradeoff between sensing rate and data transmission reliability. The source may generate data at desired rate, but instead of transmitting original sensor readings, the source generates random projections of the readings (or so called measurements), and broadcast them to its neighbors. The relay nodes perform similar random projection operation to generate new measurements.

This process of re-projection can be considered as a generic type of network coding and therefore the proposed scheme is called compressive network coding. Finally, the sink will receive m measurements. According to the compressive sensing (CS) theory, the data reconstruction from m random measurements is nearly as good as the best m term approximation. Therefore, the sink is able to recover the original data with soft threshold (i.e. at different precisions).But CNC is sensitive in Burst transmission error. So thereby scheduling method is proposed between between the nodes. And also Honey comb method is used to increase the scalability.

II. RELATED WORKS

The central idea behind CS is that an n dimensional compressible (sparse) signal can be recovered from a small number of random linear projections. CS can potentially be applied to reduce traffic or increase throughput.

A distributed compressed sensing (DCS) framework for sensor data compression. DCS exploits both intra-signal (temporal) and inter-signal scale networks. This is because, CS works best for high dimensional signals. In small-scale sensor networks without stringent delay constraint, CS can be used to exploit the temporal correlations to improve the data gathering precision. They proposed compressive data gathering (CDG) in a large-scale WSN. The main contributions lie on how to reconstruct sensor data when abnormal readings exist or sensor readings are not correlated in adjacent neighbourhood. The objective of compressive data gathering is two-fold: compress sensor readings to reduce global data traffic and distribute energy consumption evenly to prolong network lifetime. Similar to distributed source coding, the data correlation pattern shall be utilized on the decoder end. Besides, compression and routing are decoupled and therefore can be separately optimized. The intuition behind CDG is that higher efficiency can be achieved if correlated sensor readings are transmitted jointly rather than separately. The sensor readings are combined while being relayed along a chain-type topology to the sink.. Data gathering and reconstruction of CDG are performed on the sub-tree basis.

CDG is first proposed for snapshot data collection in single-radio single-channel WSNs. The basic idea of CDG is to distribute the data collection load uniformly to all the nodes in the entire network. We take the data collection on a path consisting of L sensors $s1, s2, . . . , sL$ and one sink $s0$ as shown in Figure as an example to explain CDG.
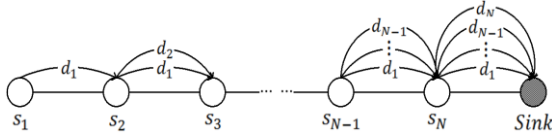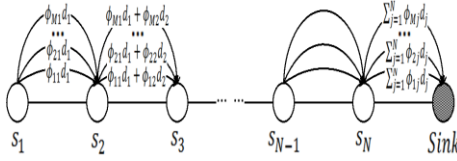
Fig 1(a): Baseline data collection

Fig 1(b): compressive data gathering

The packet produced at sensor sj $(1 \leq j \leq L)$ is dj. In the basic data collection shown in Figure (a), $s1$ transmits one packet $d1$ to $s2$, $s2$ transmits two packets $d1$ and $d2$ to $s3$, and finally all the packets on the path are transmitted to $s0$ by sL. Obviously, nodes near the sink has more transmission load compared with nodes far from the sink in the basic data collection. To balance the transmission load, they proposed the CDG method as shown in Figure (b).

Instead of transmitting the original data directly, $s1$ multiplies its data with a random coefficient $\phi i1$ $(1 \leq i \leq M)$, and sends the M results $\phi i1d1$ to $s2$. Upon receiving $\phi i1d1$ $(1 \leq i \leq M)$ from $s1$, $s2$ multiplies its data $d2$ with a random coefficient $\phi i2$ $(1 \leq i \leq M)$, adds it to $\phi i1d1$, and then sends $\phi i1d1 + \phi i2d2$ as one data packet to $s3$. Finally, s does the similar multiplication and addition and sends the result $\Sigma\phi ijdj$ $(1 \leq i \leq M)$ to $s0$. After $s0$ receives all the M packets, $s0$ can restore the original packets based on the compressive sampling theory [1]. By CDG, all the sensors send M packets to their parent nodes, which achieves the goal to uniformly distribute the data collection task to the entire network. The number of the transmitted packets is $O(n2)$ in Figure (a) and is $O(NM)$ in Figure (b), and usually $M \ll n$ for large scale WSNs. Therefore, CDG reduces the number of the transmitted packets.

III. EXISTING SYSTEM

DATA AND NETWORK MODEL

The source may generate data at desired rate, but instead of transmitting original sensor readings, the source generates random projections of the readings (or so called measurements), and broadcast them to its neighbors. The relay nodes perform similar random projection operation to generate new measurements. This process of re-projection can be considered as a generic type of network coding and therefore the proposed scheme is called compressive network coding[1].
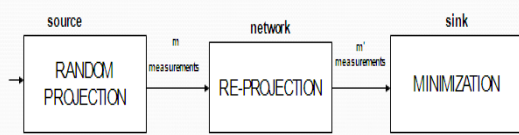

Fig 2: Compressive network coding framework

Consider a wireless sensor network with collection of sensors Si, $i = 1, 2...40$. Each sensor has a collection of sensor readings denoted by d= $\left(d_1 d_2 ... d_n\right)^T$, to report to the sink. It is believed that d is compressible in a certain domain Ψ which is known to the sink but may not be known to the

sensor. The compressibility is defined as follows. Denote $\Psi = [\psi1\psi2...\psi n]$, $\psi i \in \mathrm{R}^n$, $i = 1, 2, ...n$ as a set of ortho normal basis. Expand d in the Ψ basis:

$$d = \sum_{i=1}^{n} x_i\psi_i, \text{ or } d = \Psi\mathrm{X}$$

Let us sort the transform coefficients $\{xi\}$, $i = 1...n$ in descending order according to their absolute values and obtain $\{xi1, xi2 ...xin\}$. The best k-term approximation of d, denoted by $d^{\wedge}(k)$, is define as:

$$\mathbf{d}^{(k)} = \sum_{i=1}^{k} x_{i_j}\psi_{i_j}$$

Each sensor can communicate with the sink and other sensors through highly unreliable links. Denote li as the delivery ratio from sensor Si to sink D, and denote lij as the delivery ratio between sensor Si and Sj. Then li, $lij \ll 1$. In such a network, multi-path routing is allowed to fully exploit the broadcast nature of wireless medium.

CNC AS A JOINT SOURCE AND NETWORK CODING SCHEME

CNC accomplishes joint source and network coding through the same random projection operation. In the process of source s generates a matrix of random coefficients, denoted by Φs or $\{\varphi sij\}$, and produces m measurements:

$$\mathbf{y}^s = \begin{pmatrix} \phi_{11}^s & \cdots & \phi_{1n}^s \\ \phi_{21}^s & \cdots & \phi_{2n}^s \\ \vdots & & \vdots \\ \phi_{m1}^s & \cdots & \phi_{mn}^s \end{pmatrix} \begin{pmatrix} d_1 \\ d_2 \\ \vdots \\ d_n \end{pmatrix} = \Phi^s \mathbf{d}$$

When d is compressible, m is smaller than n. Therefore, transmitting the measurements consumes less energy than transmitting the original readings.

Random re-projection is performed at each intermediate node to increase diversity. Suppose node r decides to relay mr measurements for source s, it then randomly generates the new measurements with:

$$\mathbf{y}^r = \Phi^r \mathbf{y}_{s,r} = \Phi^r \Lambda_{s,r} \Phi^s \mathbf{d}$$

where Φr is an $mr \times ms,r$ random matrix. The value of mr is decided by a distributed utilization optimization algorithm.Finally, the sink receives $m\_$ messages, possibly from multiple paths. The entire random projection based joint source network coding process can be described by:

$$\mathbf{y}^D = \Phi_N \Phi^s \mathbf{d} = \Phi \mathbf{d}$$

where ΦN represents the network coding coefficients and Φs represents the source coding coefficients.

When d is sparse or compressible, it can be perfectly reconstructed from y under certain conditions. According to CS theory, data reconstruction can be achieved through solving $l1$-minimization problem:

$$\min_{\mathbf{x} \in \mathbb{R}^N} \|\mathbf{x}\|_{l_1} \quad s.t. \quad \mathbf{y} = \Phi\mathbf{d}, \ \mathbf{d} = \Psi\mathbf{x}$$

It is known that can be computed by linear programming. It stated that the average squared error of CS reconstruction from m random projections is upper bounded by a constant times $(m/\log n)^{-2\alpha}$, nearly as good as the best m-term approximation.

In order to solve, matrices ΦN and Φs should be known to the sink. The overhead of transmitting ΦN matrix in CNC is the same as that in conventional random linear network coding. A commonly adopted approach is to include the network coding coefficients in each transmission block. It has pointed out, the relative overhead of transmitting these coefficients decreases with increasing length of blocks over which the codes and network remain constant. Matrix Φs does not need to be transmitted with data packets. It can be obtained by the following process: before data transmission, the sink broadcasts a random seed to the entire network.

Then, each sensor generates its source coding matrix using this global seed and its unique identification. With the same pseudo random number generator, the sink can reproduce the source coding matrices for all sensors. Finally, the existing system shows delivery ratio with 60% for 40 nodes in network.

NETWORK CODING AND NETWORK UTILITY MAXIMIZATION

The idea of network coding is first proposed in error-free wired network for single source multicast to achieve network capacity. MORE performs intra-flow network coding in a wireless multi-hop network. Network coding ensures that multiple nodes that hear the same transmission do not forward the same packet. The combination of random network coding and opportunistic routing efficiently exploits the broadcast nature of wireless medium and combats losses

NETWORK UTILITY MAXIMIZATION FOR CNC FLOWS

In monitoring sensor networks, all sensors collect data and create multiple concurrent flows. Each sensor node, while being the source of its own flow, may also relay data for other sources. Most sensors even need to relay data for multiple flows. Therefore, we shall address the network utility maximization (NUM) issue for CNC flows. In this research, special emphasis is put to tackle the high unreliability of sensor communications. At this point, we do not explicitly bring in MAC constraint in our NUM formulation, because the transmission energy, not wireless medium, is the main constraint of a data gathering network.

Demerits

1. CNC is sensitive in burst   transmission error.
2. CNC is used for source nodes alone Scalability is restricted

IV. PROPOSED WORK

CREATING THE BANDWIDTH EFFICIENT NETWORK TO ANALYZE BURST ERROR.

When the source is requested by two different destinations operating in different bandwidths a deadlock like condition occurs which produces congestion at the source level. To avoid this problem have to schedule the data based on bandwidth lifetime. Design a network with n nodes with a

constant bandwidth and increase the throughput for each transmission. Observe the following:

- TTL of the active link
- Maximum data transferred

The source is requested by two different destinations operating in different bandwidths, deadlock condition occurs. It raises congestion at the source level. To avoid this problem, have to schedule the data based on bandwidth lifetime and message type.
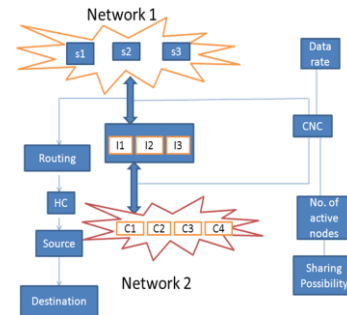

Fig 3. System Architecture of proposed system

HONEY COMB METHOD

The HC method is proposed to extend the CNC to other nodes in a network. In a homogenous network CNC can be extended to destination node other than source. In a heterogeneous network, the CNC can be implied to intermediate node other than source and destination. HC is a spreading mechanism. It opts the routing path to reach the other nodes. It supports directed, bi-directional and random paths for improving the states. When a network size varies, HC opts a routing and can be extended. Thus it supports scalability. As the drawback of scalability is overcome in HC implemented network, unobservability and out of range problem are minimized in a network.

APPLYING CNC IN SOURCE AND DESTINATION.

Source directed and destination directed CNC can be implemented in homogeneous network. Intermediate nodes can also use this CNC in heterogeneous network. As the drawback of scalability is overcome in HC implemented network, Un-observation ability and out of range problem are minimized in a network.

V. CONCLUSION AND FUTURE WORK

In the existing system they have presented a CNC framework for sensor data gathering which unifies source coding and network coding under the same random projection operation and We have formulated a NUM problem. Simulations over real sensor data have shown that CNC is not working in burst transmission errors. In this paper, scheduling method is proposed to reduce the burst transmission error and Honey Comb method is used to increase scalability. In the future, this CNC to exploit both temporal and spatial correlations among sensor readings, to achieve potentially higher compression ratio and shorter latency.

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