

Rapid Data Collection in Wireless Sensor Networks Organized as Trees



Engineering

KEYWORDS : Converge cast, Multi Frequency Channel , Transmission power Control.

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ABSTRACT

To increase the data collection in WSN organized as trees there are different techniques. One of the technique is evaluating many to one communication model known as converge cast with realistic simulations. First time scheduling on a single frequency channel is considered. The main aim of this scheduling is to minimize the number of time slots (or) schedule lengths to complete converge cast. Next scheduling is combined with transmission power control to reduce the effects of interference. It also shows that power control which helps in reducing the schedule length, under single frequency is less efficient compared with scheduling transmissions using multiple frequencies. As interference effects are reduced, lower bounds on schedule length are given and algorithms are proposed in order to achieve efficient data collection. The performance of various channels is evaluated and found that, the use of multi-Frequency scheduling is enough to eliminate interference in moderate size networks (min 100 nodes). As interference is removed, data collection is very easy now using the tree topology. By the end, a degree constrained spanning trees & capacitated minimal spanning trees are constructed. Scheduling performance is also improved over different deployment densities. Finally, the impact of different interferences and channel models on the schedule length is evaluated.

2. INTRODUCTION

Data gathering is a common task in wireless sensor networks. Nodes are deployed in order to collect and report sensor readings to a single sink, that is it writes all data to a database. In general, the covered area of a many to one setup exceeds the communication range of sensor nodes. Besides, reducing the communication range by decreasing transmission power helps saving energy and avoids interference. In this case, a tree rooted in the sink provides a suitable routing environment. In order to achieve reliable communication, an energy-efficient mechanism avoiding packet loss is needed. Additionally, nodes possibly have to store own sensor readings and must forward foreign data towards the sink. Hence, buffer management must be considered. When setting up a data-gathering application, some major issues have to be considered[1]. Converge cast network is a special type of wireless adhoc network, which concerns many-to-one transmission. In each session, k sources and one destination are randomly selected from n nodes in the network, and the remaining nodes act as relays. These k distinct sources transmit different packets to the destination, either directly or via multiple relays. A successful transmission is completed when all the k packets reach the destination.[2] Energy is one of the most critical resources in WSNs, and energy consumption should be carefully managed so that network lifetime can be maximized. Wireless communication is the major source of energy consumption in wireless sensor networks.[3]. The data generated by sensor nodes may contain a lot of redundant data since sensor nodes are commonly densely deployed. Data aggregation is the combination of data from different sources according to a certain aggregation function, eliminating redundancy, minimizing the number of transmissions and thus saving energy.

3. RELATED WORK

We study aggregated converge cast[9] in the context of continuous data collection, and raw data converge cast for one-shot data collection. These two types correspond to two extreme cases of data collection. We focus on the problem of energy-efficient converge cast in sensor networks[3]. This problem identifies the energy-latency trade off during converge cast. Whenever a group of sensors communicate an event of interest, the latency involved in delivering such messages to the base station should be minimized. Since the sensors are constrained by limited power and are mostly idle, it is important that the sensors conserve energy. We show how time division multiple access (TDMA)[8] can be effectively used to provide energy-efficient converge cast. This solution allows the sensors to save energy when the network is idle and to switch to active mode when the network observes an event. The main objective was minimiz-

ing the completion time of converge casts. Fast data collection was not concentrated. Mainly, Scheduling on single frequency channel is considered, which reduced the time slots to complete converge cast. There are three extreme cases of data collection which were not considered and are the drawbacks of existing system. The effect of combining scheduling lengths with Multiple frequencies is not considered. The problems of aggregated and raw data converge casts are not considered. Limitations due to converge casts are also not considered. Now in proposed system we consider, Fast Data Collection with minimum schedule lengths for aggregated converge cast has been considered. The impact of transmission power control and multiple frequency channels on schedule length is experimentally investigated. Lower bounds on the schedule length for tree based networks are computed with algorithms. Comparison of efficiency of different channel methods and interference models is done and schemes are proposed for constructing routing tree topologies. These constructed routing tree topologies improve data Collection rate both in aggregated converge cast and raw data converge cast. To construct the Degree based constrained spanning trees.

4. IMPLEMENTATION

Real implementation and deployment will help in addressing the problems of intermittent connectivity and channel errors with unreliable links and handling asymmetric links.

3.1 Periodic Aggregated Converge cast.

3.2 Transmission Power Control

3.3 Aggregated Data Collection

3.4 Raw Data Collection

3.5 Tree-Based Multi-Channel Protocol (TMCP)

3.1 Periodic Aggregated Converge cast

Data aggregation is a commonly used technique in WSN that can eliminate redundancy and minimize the number of transmissions, thus saving energy and improving network lifetime. Aggregation can be performed in many ways, such as by suppressing duplicate messages; using data compression and packet merging techniques; or taking advantage of the correlation in the sensor readings. We consider continuous monitoring applications where perfect aggregation is possible, i.e., each node is capable of aggregating all the packets received from its children as well as that generated by itself into a single packet before transmitting to its parent. The size of aggregated data transmitted by each node is constant and does not depend on the size of the raw sensor readings.

3.2 Transmission Power Control

We evaluate the impact of transmission power control[6], multiple channels, and routing trees on the scheduling performance for both aggregated and raw-data converge cast.. Although the techniques of transmission power control and multi-channel scheduling have been well studied for eliminating interference in general wireless networks, their performances for bounding the completion of data collection in WSNs have not been explored in detail in the previous studies. The fundamental novelty of our approach lies in the extensive exploration of the efficiency of transmission power control and multichannel communication on achieving fast converge cast operations in WSNs[5].

3.3 Aggregated Data Collection

We augment their scheme with a new set of rules and grow the tree hop by hop outwards from the sink. We assume that the nodes know their minimum-hop counts to sink[7].

3.4 Raw Data Collection

The data collection rate often no longer remains limited by interference but by the topology of the network. Thus, in the final step, we construct network topologies with specific properties that help in further enhancing the rate. Our primary conclusion is that, combining these different techniques can provide an order of magnitude improvement for aggregated converge cast, and a factor of two improvement for raw-data converge cast, compared to single-channel TDMA scheduling[8] on minimum-hop routing trees.

3.5 Tree-Based Multi-Channel Protocol (TMCP)

TMCP is a greedy, tree-based, multi-channel protocol for data collection applications[10].

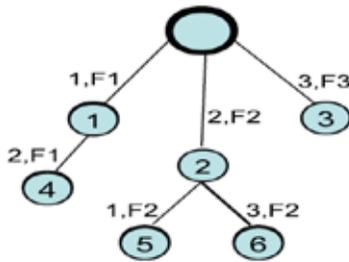


Fig 1: Schedule generated with TMCP

It partitions the network into multiple sub trees and minimizes the intra tree interference by assigning different channels to the nodes residing on different branches starting from the top to the bottom of the tree. Figure shows the same tree given in Fig 1. which is scheduled according to TMCP for aggregated data collection[10]. Here, the nodes on the leftmost branch is assigned frequency F1, second branch is assigned frequency F2 and the last branch is assigned frequency F3 and after the channel assignments, time slots are assigned to the nodes with the BFS Time Slot Assignment algorithm.

Advantage of TMCP is that it is designed to support converge cast traffic and does not require channel switching. However, contention inside the branches is not resolved since all the nodes on the same branch communicate on the same channel[4].



Fig.2a Schedule length of 6 in the presence of interfering links.

	Frame 1						Frame 2					
	S1	S2	S3	S4	S5	S6	S1	S2	S3	S4	S5	S6
5	1	2	3	-	-	-	(1,4)	(2,5)	3	-	-	-
1	-	-	-	4	-	-	-	-	-	4	-	-
2	-	-	-	-	5	6	-	-	-	-	5	6

Fig 2b Node ids from which packets are received by their corresponding parents in each time slot over different frames.

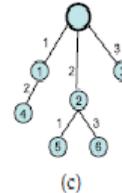


Fig.2c Schedule length of 3 using BFS-TIME SLOT ASSIGNMENT when all the interfering links are eliminated.

4. EXPERIMENTAL EVALUATION

Here the discussion is about performance report of proposed model. In order to analyze statics report of proposed network model, To have evaluated various scenarios for determining performance report of SPM and Privacy preserving model by employing various experiments. However security always impact on performance, the entire study has concerned with security with performance prospective.

In any mobile networks security always consumes an energy; the entire study described various security solutions and its impact on performance report. According to my research work, the main aim is to produce better security with better performance by computing different scenarios. In this chapter To describing about performance report and To presenting results by presenting different models performance report and its comparison

Estimation of 100 nodes network model throughput

This experiment analyze network throughput performance of special nodes and ordinary nodes among 100 mobile nodes, In last experiment we have computed throughput by configuring 50 mobile nodes and we estimated performance but in this experiment we have increased number of nodes in order to observer performance variance. However throughput always consider successful packet delivery ratio, according to the above graph the throughput computation varies with different interval rate, here we have assigned different interval rate for observing 100 node network model performance rate. According to the above report the throughput rate varies from different intervals and it plotted better throughput performance for different network loads. On x-axis: throughput of nodes, and y-axis: interval rates.

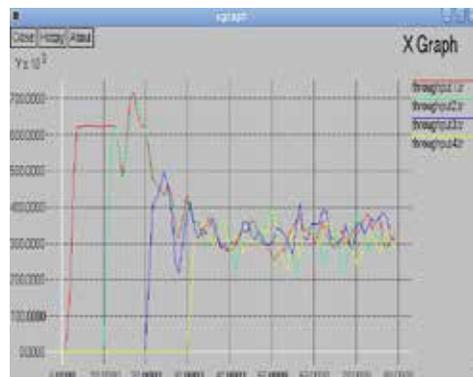


Fig 3: Graph of estimation of 100 nodes network throughput Estimation of Packet loss for 100 nodes with different intervals

On x-axis indicates packet losses of nodes, and y-axis indicates interval rates. The loss rates are calculated for the observation interval time here we have taken different interval times, more ever the loss rate also calculated in shortest interval. It measures start time and end time to observe packet loss rate during packet flow across nodes. The time interval between 200 sec and 300 sec is enlarged and shown in figure (bottom) for T = 1 sec and T = 5 sec. The decrease in the interval over which the loss rate is calculated shows that there exists a variability in the loss rates that cannot be captured by specifying only the long-term average loss rate.

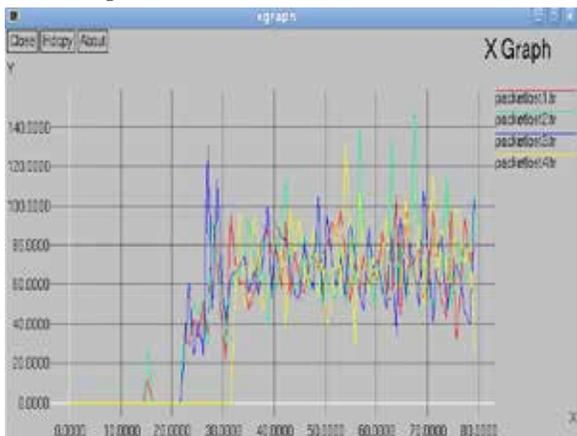


Fig 4: Graph of estimation of packet loss of 100 nodes at different intervals

Loss rate represents an aggregate measure of the underlying loss process, and it does not provide sufficient information about the loss distribution within the observed time interval.

End to end delay for 100 nodes

The average time taken by a data packet to arrive at the destination. It also includes the delay caused by route discovery process and the queue in data packet transmission. Only the data packets that successfully delivered to destinations that counted.

$$\text{Average delay} = \frac{\sum (\text{arrive time} - \text{send time})}{\sum \text{Number of connections}}$$

The lower value of end to end delay means the better performance of the protocol. The results for the three protocols are shown in Figure. The average packet delay of DSDV in the graph walk model is greater than in random walk model. The explanation is that the spatial constraint of graph forced more hops to be used on detours along the graph than in random walk. Surprisingly, in contrast, DSR and AODV both achieve lower delay in graph walk than in random walk even with more hops needed.

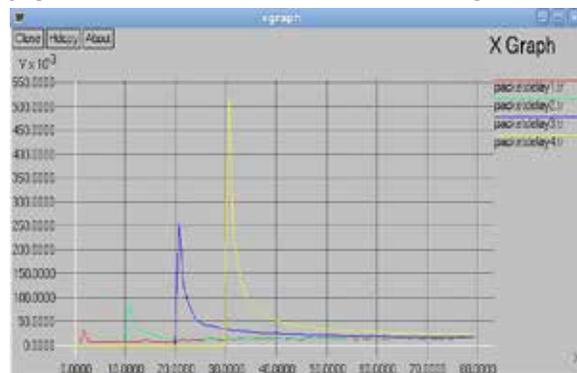


Fig 5: Graph of estimation of packet delay of 100 nodes at different intervals

On x-axis indicates packet delays of nodes, and y-axis indicates interval rates. This is because of the different major factors impacting the delay time: while the delay of AODV and DSR is mainly caused by undeliverable packets, the number of hops

plays a critical role in DSDV. When the value of is significantly less than 1, also the much greater than , which indicates a higher radio coverage density of nodes in graph walk than in random walk with the same number of nodes and radio

Node mobility for 100 nodes

In the presence of high mobility, link failures can happen very frequently. Link failures trigger new route discoveries in AODV since it has at most one route per destination in its routing table. Thus, the frequency of route discoveries in AODV is directly proportional to the number of route breaks.

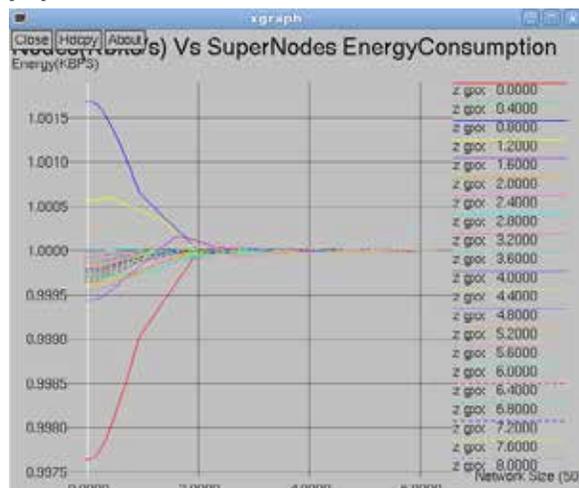


Fig 6: Graph for node mobility of 100 nodes at different energy levels

On x-axis indicates network size, and y-axis indicates energy (KBPS).The reaction of DSR to link failures in comparison is mild and causes route discovery less often. The reason is the abundance of cached routes at each node. Thus, the route discovery is delayed in DSR until all cached routes fail. But with high mobility, the chance of the caches being stale is quite high in DSR.

Energy consumption for 100 nodes

From this chart, we see that the energy delivery performance is almost identical for DSR and AODV, for the conditions of our simulation From this we see that for the simulation cases that we have studied, the DSR algorithm offers the best combination of energy consumption performance and the data delivery performance. On x-axis: network size, on y-axis: energy (KBPS). The above graph shows the corresponding performance of the algorithms in terms of the average energy ratios.

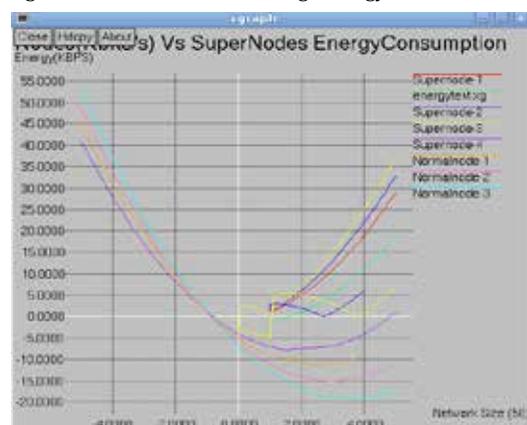


Fig 7: Graph for energy consumption of 100 nodes at different energy levels

Protocol overhead for 100 nodes Performance of DSR for 50 nodes, 100 nodes and 150 nodes

When low mobility DSR performs very well and delivers close

to 95% of its packets. At high mobility, the throughput drops to about 50%. The throughput in DSR also decreases as a function of the number of nodes in the network. At high load, high mobility and large number of nodes, the throughput can be as low as 50%.

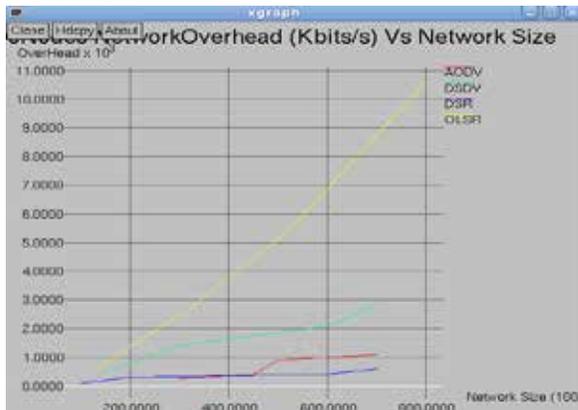


Fig 8: Graph for network overhead of 100 nodes at different network sizes

On x-axis indicates network size(100 nodes), and y-axis indicates work overhead* 10^3 (Kbits/s).The per-packet overhead in DSR is high because it embeds the complete source route in the packet header.

This overhead can reach 100% for small sized- packets. DSR tend to keep the routing overhead relatively low even under high loads and large number of nodes. DSR finds close to optimal routes in most cases. Underneath low network loads, the average end-to-end delay in DSR is very low. However, the average delay can increase 5-6 times for modest to high network loads.

Performance of AODV for 50 nodes, 100 nodes and 150 nodes

The AODV shows well performance in networks of up to 100 nodes regardless of node mobility and network load. Under these conditions, it delivers close to 95% of its packets and the throughput can approach 100% in fairly static networks. The throughput decreases as the number of nodes increases due to longer routes and higher collision rate. At number of nodes becoming more, the throughput becoming low .The packet delivery ratio also drops with increase in nodal mobility. The routing overhead is lower than proactive protocols but is high compared to DSR. However, AODV outperforms DSR in terms of

per-packet overhead. Larger number of nodes, the throughput can drop to 50%. Unlike many protocols, AODV does not find the optimal route in most cases and the difference in the optimal route and the route found by AODV can be up to four hops. It is interesting to note that the average delay in AODV decreases as the mobility increases.

Performance of TORA for 50 nodes, 100 nodes and 150 nodes

When the numbers of nodes are low, TORA performs very well even at the highest rate of node mobility and delivers about 93% of its packets. TORA is based on the theory of link reversal and this can build the configuration of short lived routing loops. This problem is responsible for greater part of the packet drops in TORA. The performance of TORA suffers a ruthless joggle as the number of nodes increases and the packet delivery ratio can fall to about 9% in huge networks. TORA fails to converge in huge networks with high mobility rates and can undergo a congestive collapse. However, the performance of TORA is poor compared to Protocols found that TORA had the most overhead compared to these protocols. The routing overhead in TORA is the sum of constant mobility-independent overhead (due to neighbor sensing) and variable mobility-dependent overhead.

5. CONCLUSION AND FUTURE WORK

To minimize the schedule length studied fast converge cast in WSN where nodes communicate using a TDMA protocol. To overcome this, Addressing the fundamental limitations due to interference and half-duplex transceivers on the nodes and explored techniques are used. It is found that while transmission power control helps in reducing the schedule length, multiple channels are more effective. Once interference is completely eliminated, we proved that with half-duplex radios the achievable schedule length is lower-bounded by the maximum degree in the routing tree for aggregated converge cast, and by max $(2nk - 1, N)$ for raw-data converge cast. It is also observed that node-based (RBCA) and link-based (JFTSS) channel assignment schemes are more efficient in terms of eliminating interference as compared to assigning different channels on different branches of the tree (TMCP). Using optimal converge cast scheduling algorithms, we showed that the lower bounds are achievable once a suitable routing scheme is used. Through extensive simulations, we demonstrated up to an order of magnitude reduction in the schedule length for aggregated, and a 50% reduction for raw-data converge cast. In future, we will explore scenarios with variable amounts of data and implement and evaluate the combination of the schemes considered.

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