Efficient Load Balancing and Extending Lifetime using Cost-Aware Secure Routing Protocol in WSN

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ABSTRACT

A Wireless sensor network can be specified as system devices that can convey the information mustered from a monitored field through wireless links. WSN consists of sensor vertex with infinite battery processing capability and slighted non-rechargeable electrical power. Energy consumption in Wireless Sensor Networks is a notable barrier in networks for increasing network duration. It is necessary to develop a cost aware routing protocol in Wireless Sensor Networks to minimize energy consumption for maximizing network duration. While the project address issue of battery power and network duration. To improve the network duration enhanced by Cost Aware Secure Routing Protocol through load balancing. Cost Aware Secure Routing protocol is used to deliver the information from a source vertex to root vertex with higher load balance. Cost Aware Secure Routing protocol is used to increase the lifetime of the network and reduce the aggregation time and also the technique of ON/OFF Scheduling can be used. The performs of ON/OFF schedule is when the vertex can appear at that time only the working vertex can be ON at the time the other vertex are in the OFF state. The technique is used to improve our network duration and also to improve our battery power. The battery power will be increased by recharging that drained vertex. The main advantage of Cost Aware Secure Routing protocol is used to improve the network duration and battery power.

KEY WORDS: Data Collection Tree, Load Balancing, Network Lifetime, Wireless Sensor Networks, Neighbor Coverage Self-Organizing Routing Protocol (NCSOTR), Cost Aware Secure Routing Protocol (CASER).

1. INTRODUCTION

Wireless Sensor Networks (WSNs) are enlarge being deployed in a large variation of applications that range from environmental monitoring to security surveillance, and from event detection to healthcare. Sensor vertex is huge electrical-powered devices with wireless communication capabilities and very limited resources. They operate unattended, as they may be randomly deployed over the sensing area due to the roughness of the terrain or even the inaccessibility of the physical environment. In most scenarios, sensed data are reported to a data gathered point (called sink) by organizing the WSN into a data gathering tree.

Due to the infinite energy budget of sensor vertex, energy preservation is one of the foremost major challenges in WSNs. The commonly adopted energy conservation approaches rely on techniques such as efficient duty cycling, data aggregation, and load balancing. Unlike the first two resemble, strategy established on load balancing explicitly focus on arranging the network topology in a way that balances the data convey the information to sensor vertex.

It has been shown that only a handful of the vertex may determine the network lifetime. Since such vertex is responsible for a large share of the total traffic, their energy depletion is extremely critical. This is particularly relevant in application scenarios that mandate reliable collection of all data, such as networked industrial control and cyber-physical systems. Thus, it is of most importance to extend the network duration by spreading the energy utilization as uniformly as possible.

The duration of WSNs is defined in different ways in the research literature. Our work addresses the duration can be maximized of data gathering tree and considers the network duration as the time progressed until the first vertex in the network exhaust all of its energy. This definition is application-independent and, thus, is suitable for diverse scenarios. Accordingly, our work aims at maximizing lifetime by building an energy- efficient data collection tree.

Approaches established on load balancing seek to increase the network duration by creating a balanced data collection tree. Such a tree needs not to be unchanging, but can rather be dynamically updated can establish on the vertex' residual energy. This method poses two major challenges. The first is scalability, as load balancing in dense WSNs with a many numbers of the vertex may require significant resources, in terms of both running time and communication raised. The second challenge is effectiveness, as dynamic load bearing schemes need to coincide a data gathering tree that effectively extends the network duration. This paper specifically addresses these challenges by proposing a novel and efficient randomized approach to load balancing in WSNs.

The major benefaction of this paper is as follows. First, we initiate a hardback neighbour coverage routing protocol, called Neighbour Coverage Self-Organizing Tree-Based Routing (NCSOTR) Protocol, to increase the network duration established from the concept of bounded balanced trees. NCSOTR applies controlled exploration of data gathering trees to find the most balanced ones, thus maximizing the network duration. Second, we analytically show that NCSOTR converges with a running time that is significantly lower than that of other approaches to load balancing in WSNs. We also intention for a scatter version of our proposed technique, called On-Off Scheduling. Through an extensive performance study that includes simulation of large-scale scenarios on a WSN, we also show that the proposed NCSOTR routing protocol and its distributed version are both scalable and efficient. Specifically, they outperform the existing state of the art in large variations of conditions, including diverse traffic patterns and vertex densities, under different definitions of network lifetime.

Related works: Incel (2012), discussed false data collection in a tree based WSN. The main concept of the scheduling techniques perform for collecting data is used by Time Division Multiple Access (TDMA). To guarante e the tight-time scheduling and high overall network throughput under high load conditions. TDMA-based MAC protocol, the total time duration of communication is divided into a fixed number of time slots. The algorithm is to construct degree constrained tree and capacitated spanning tree in order to reduce the number of bottleneck vertex for scheduling purposes. The main focus of this algorithm to reduce the schedule length. But the adjacent channel interference cannot always be ignored.

Xu (2011), introduce Delay efficient algorithm for data aggregation in WSN. In multihop WSN using data aggregation scheduling problem to minimize the delay. The distributed algorithm produces a collision-free schedule for data aggregation in WSN. Data aggregation is critical to the network performance in WSN and aggregation scheduling is a feasible way to improve the quality. One of the issue in distributed scheduling must need fast algorithm in data aggregation to solve the large dense problem.

Liang (2010), discover an efficient algorithm for constructing maximum lifetime tree for data gathering without aggregation in WSN. Data gathering is a broad research area in WSN. The lifetime of the network is defined as the time until the first vertex can deplete the energy. The key challenge is data gathering without aggregation is to conserve the energy consumption among vertex so as to maximize the network lifetime. This algorithm may be challenged to construct a min-max weight spanning tree, in which the bottleneck vertex had the least number of descendants according to their energy. The main issue of the efficient algorithm problem is NP-complete. Another disadvantage of the network topology can change dynamically i.e. some vertex die. When they exhaust their energy or are broken, a tree should not be used for a long lifetime.

Luo (2011), introduce Maximizing lifetime for the shortest path aggregation tree in WSN. It can be used to find the shortest path tree with the maximum lifetime in-network aggregation. The advantage of the data aggregation is to find an optimal shortest path tree with the maximum lifetime. One of the main issue when the vertex density is varied the overhead increase linearly.

Kasbekar (2011), discover Lifetime and coverage guarantees through distributed coordinate-free sensor activation in WSN. The help of this techniques is designed a polynomial-time used by distributed algorithm. One of the significant in distributed algorithm can achieve maximum lifetime. The major disadvantage in distributed algorithm is network lifetime ends once one of the intersection points does not belong to the K-coverage target field.

Kajal Arefin Imon (2015), introduce Energy Efficient Randomized switching for maximizing lifetime in tree-based WSN. The RaSMaLai algorithm used to extend the lifetime of the network through load balancing. The algorithm can be used to randomly switch some sensor vertex from their original path to other paths with lower loads. The main disadvantage of the algorithm is to increase the convergence time and battery replacement.

2. PROPOSED SYSTEM

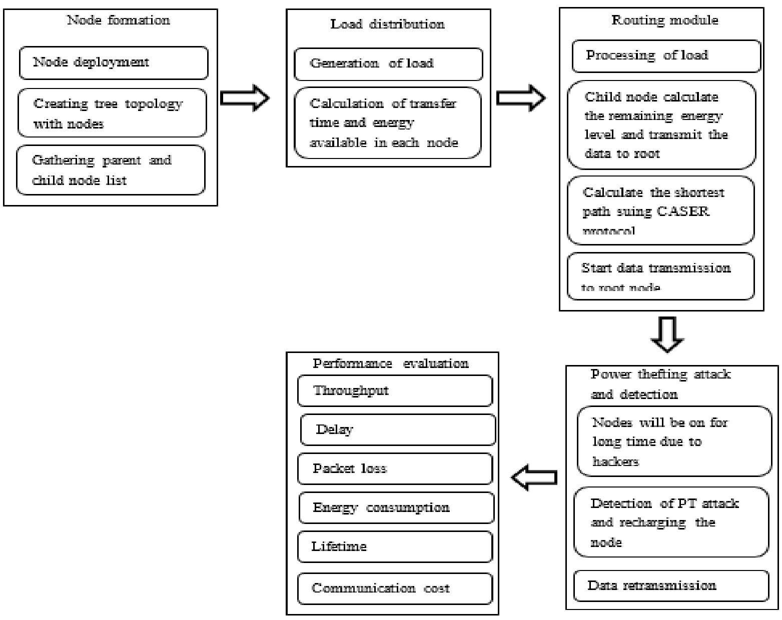

Figure.1. System Architecture

Fig.1, shows to describe the initial vertex can be formed randomly in a tree topology. It can deploy N sensor vertex. To gather the information of parent and child vertex from root vertex. Second, each sensor vertex generate the load randomly for each transformation time. Then the load can be managed and then calculate remaining energy level for root vertex and also calculate for the shortest path using CASER protocol, then the source vertex can start the transformation to the root vertex. Then the third step, whether any vertex can be ON state at over the time, then that vertex could be affected by any attacker, so that vertex battery power or energy can be drained, then the battery can be recharged then the data can be retransmitted to the root vertex. Finally, each sensor vertex should be calculated the performance evaluation i.e., network lifetime, communication cost, energy consumption, throughput, delay.

Cost Aware Secure Routing Protocol: To resolve the above problem, Cost Aware Secure Routing (CASER) protocol can be proposed. CASER protocol can be established on the number of vertexes presented for communicating. When the vertex will be communicated by a communication cost. The load balancing means the number of packets can generate the random key generation. It will be used to send the information from the source child vertex to root vertex, the source child vertex should be selected by the technique of scheduling. When the source child vertex can be selected then the vertex can transfer the information to their neighbour vertex. The neighbour vertex can be chosen by the interspace of the source child vertex. At the same time, the process can select another source child vertex transmission of information will be transmitted to the root vertex. One of the vertexes can be energy drained because of power theft attack can be affected that vertex. So, that vertex can recharge their battery and also the vertex should be ON state still the transformation reaches to the root vertex.

Vertex Deployment using Tree Topology: The N sensor vertex is deployed randomly with a tree topology. A group of edges representing the communication between the sensors. Each sensor vertex should initialize their position. The root vertex would be generated the parent vertex and child vertex. Each sensor vertex information can transfer from the root vertex. When ON/OFF scheduling technique can be used, all the vertex can be OFF state except the root vertex.

Load Balancing and Distribution: Load balancing should be used to generate the random key for each sensor vertex. The root vertex could be distributed the load to their parent vertex and child vertex. To calculate the energy level, each vertex can need to check the time to require load balance. Root vertex shall be portioned the workload to their child vertex. Whenever we run this technique, a new load balance can be generated for each sensor vertex at each time.

Cost Aware Secure Routing Protocol: When all the sensor vertex can be generated the load balance, then the parent vertex and child vertex go to the OFF state. CASER protocol can be used to choose the source child vertex from tree topology by using the scheduling technique. Then the source child vertex to select their neighbour vertex by shortest distance from their child vertex. For the purpose of transferring the information from child vertex to their neighbour vertex. Similarly, the process can be maintained until to reach the root vertex. When the process can end up to the root vertex can receive the information from source vertex.

Power Theft Attack: In power shifting method, the power can be shifted by an attacker so the battery can be drained. To improving the battery power, the vertex can be recharge by the recharging vertex. Now, the recharged vertex should follow the ON state. Because whether the vertex can be set as OFF state, again the battery can be drained so we will process the state until the root vertex can receive the information from source vertex.

Performance Evaluation:

Network Lifetime: Network lifetime can also represent by a remaining energy. Because when the battery contains some amount of energy, then the battery can be performed some actions it can reduce their energy when the remaining amount of energy is said to be a network lifetime. Network lifetime can be represented as joule. The time interval from the start of network operation until the death of the last alive sensor.

Throughput: When the sensor vertex can transfer the information from one vertex to another vertex in a given amount of time. It indicates the number of transactions produced over the time. It can be represented by Mbps.

Delay: The delay of a network specifies how long it takes for a bit of data to travel across the network from one vertex to another vertex. It is typically measured in multiples or fractions of seconds. Delay can differ slightly, depending on the location of the specific pair of communicating vertex.

Packet Delivery Ratio: Packet Delivery Ratio measures the robustness of protocol and is calculated by dividing the total number of dropped packets by the total number of transmitted packets. The measurement of Packet Delivery Ratio (PDR) is established on the received and generated packets as recorded in the trace file. PDR can be specified as the ratio between the received packets by the destination and the generated packets by the source.

3. SIMULATION RESULTS

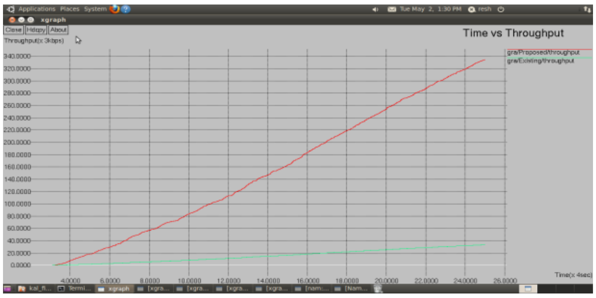

Figure.2. Throughput

Fig.2, shows that the comparison graph for Time vs Throughput. The measurement symbol of throughput will be kbps.In communication networks, such as Ethernet or packet ratio, throughput is a successful message delivery communication channel. These data may be received over a physical or logical link, can send through a certain network vertex. The throughput is usually measure by bits per second or information packets per time slot. It can be measured by maximum throughout, maximum theoretical throughput, peak throughput, normalized throughput and so on.

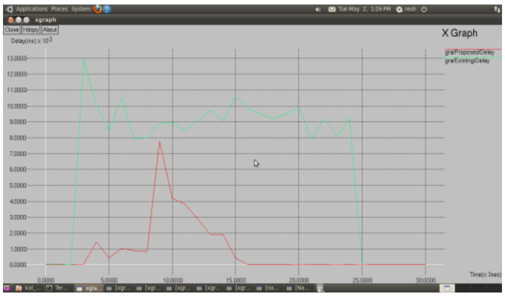

Figure.3. Delay

Fig.3, shows that the delay graph. Delay is the difference between the time at which the sender generated the packet and the time at which the receiver received the packet. Delay is measured by using the script as awk which processes the trace file and produces the result.

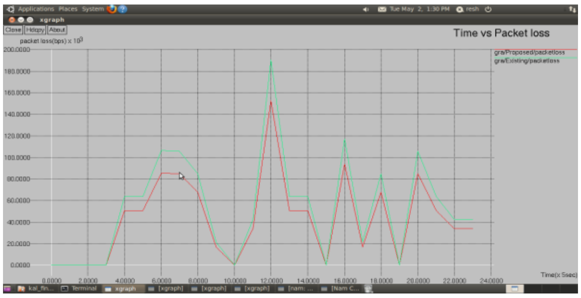

Figure.4. Packet Loss

Fig.4, shows that the comparison graph for time vs packet loss. The packet loss can be represented as kbps.Packet loss is a communication difference between the generated and received packets. Packet Loss is calculated by awk script which processes the trace file and produces the result.

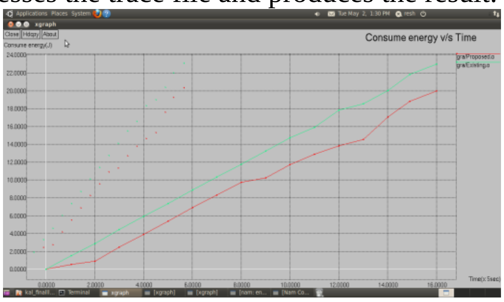

Figure.5. Energy Consumption

Fig.5, shows that the graph for energy consumption. The energy model represents the energy level of the vertex in the network. The energy model has defined in a vertex had an initial value that is the level of energy the vertex has at the beginning. This energy is termed as initial energy. A vertex losses the particular number of energy for every packet transmitted and every packet received. The energy consumption level of a vertex at any period of the simulation can be determined by finding the difference between the current energy value and initial Energy value.

4. CONCLUSION

In Wireless Sensor Network the main issue to improving battery power or energy and also improve network lifetime. To improve the battery power and lifetime of the network will be enhanced by a Cost Aware Secure Routing (CASER) protocol.Energy based routing is contributed through which network lifetime is improved further. The proposed CASER protocol follows the two routing strategies for message forwarding: a) shortest path message forwarding and b) secure message forwarding. It also balanced the energy consumption of the entire sensor network so that the lifetime of the WSNs can be maximized. CASER has the flexibility to support multiple routing strategies in message forwarding to extend the lifetime while increasing routing security. The protocol also provides a secure message delivery option to maximize the message delivery ratio under adversarial attacks. CASER protocol has two major advantages: (i) It ensures balanced energy consumption of the entire sensor network so that the lifetime of the WSNs can be maximized. (ii) CASER protocol supports multiple routing strategies based on the routing requirements, include fast or slow message delivery and secure message delivery to prevent routing trace back attacks and malicious traffic jamming attacks in WSNs. Another some advantages are secure and efficient Cost-Aware Secure Routing (CASER) protocol for WSNs. The protocol, cost-aware based routing strategies can be applied to address the message delivery requirements. We devise a quantitative scheme to balance the energy consumption so that both the sensor network lifetime and the total number of messages that can be delivered are maximized under the same energy deployment (ED).

REFERENCES

Anastasi G, Conti M and Di Francesco M, Extending the lifetime of wireless sensor networks through adaptive sleep, IEEE Trans. Ind. Inf., 5 (3), 2009, 351–365.

Anastasi G, Conti M, Di Francesco M and Passarella A, Energy conservation in wireless sensor networks: A survey, Ad Hoc Netw., 7, 2009, 537–568.

Chen T.S, Tsai H.W and Chu C.P, Adjustable converge cast tree protocol for wireless sensor networks, Comput. Commun., 33, 2010, 559–570.

Dai H and Han R, A vertex-centric load balancing algorithm for wireless sensor networks, in Proc. IEEE GLOBECOM, 1, 2003, 548–552.

Fyffe M, Sun M.T and Ma X, Traffic-adapted load balancing in sensor networks employing geographic routing, in Proc. IEEE WCNC, 2007, 4389–4394.

Incel O.D, Ghosh A, Krishnamachari B and Chintalapudi K, False data collection in tree-based wireless sensor networks, IEEE Trans. Mobile Comput., 11 (1), 2012, 86–99.

Kajal Arlen Imon Sk, Adnan Khan, Mario Di Francesco and Sajal Das K, Energy Efficient Randomized switching for maximizing lifetime in the tree based wireless sensor networks, IEEE/ACM Trans. Netw., 2015.

Kasbekar G.S, Bejerano Y and Sarkar S, Lifetime and coverage guarantees through distributed coordinate-free sensor activation, IEEE/ACM Trans. Netw., 19 (2), 2011, 470–483.

Liang J, Wang J, Cao J, Chen J and Lu M, An efficient algorithm for constructing maximum lifetime tree for data gathering without aggregation in wireless sensor networks, in Proc. IEEE INFOCOM, 2010, 1–5.

Luo D, Zhu X, Wu X and hen G, Maximizing Lifetime for the shortest path aggregation tree in wireless sensor networks, in Proc. IEEE INFOCOM, 2011, 1566–1574.

Madden S.R, Franklin M.J, Hellerstein J.M and Hong W, Tiny DB, An acquisitional query processing system for sensor networks, Trans. Database Syst., 30 (1), 2005, 122–173.

Wang Z, Bulut E and Szymanski B, Energy efficient collision aware multipath routing for wireless sensor networks, in Proc. IEEE ICC, 2009, 1–5.

Wu Y, Mao Z, Fahmy S and Shroff N, Constructing maximum lifetime data-gathering forests in sensor networks, IEEE/ACM Trans Netw., 18 (5), 2010, 1571–1584.

Xu X, Li X.Y, Mao X, Tang S and Wang S, A delay-efficient algorithm for data aggregation in multihop wireless sensor networks, IEEE Trans. Parallel Distrib. Syst., 22 (1), 2011, 163–175.

Zhao Q and Gurusamy M, Lifetime Maximization for connected target coverage in wireless sensor networks, IEEE/ACM Trans. Netw., 16 (6), 2008, 1378–1391.