International Journal of
Emerging Research in Management &Technology
ISSN: 2278-9359 (Volume-4, Issue-1)

Research Article | **January 2015**

Lifetime Analysis of a Slotted Aloha-Based Wireless Sensor Network Using a Cross-Layer Frame Rate Adaptation Scheme: A Review

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Abstract:

Cross –layer design has been widely used in wireless sensor networks,especially to improve the network lifetime,as can be seen in the literature.In this paper,a cross-layer solution is combined to a transmission advertisement sheme to improve a small slotted ALOHA-based wireless sensor network throughput and lifetime.This medium access method scheme has been chosen because it does not add protocol information that is transmitted with data bits,when compare to other medium access methods it reducing transmission overhead.Finally,the advertisement scheme and the combination of a cross-layer design has proven to increase the network throughput by more than 10% and when compared to a slotted ALOHA wireless sensor network advertisements,then it double the network lifetime.

Keywords: ALOHA, Cross-Layer Design, Frame Rate Adaptation, Network Lifetime, Wireless Sensor Networks (WSNs).

I. INTRODUCTION

A wireless sensor networks is a collection of nodes and organized in cooperative network**.** The creation of small devices capable of sensing data and transmitting them through the wireless medium has allowed many interesting applications to be implemented.Networks made by these devices are called wireless sensor networks(WSNs),and their organization in networks has enabled applications to be widespread.Some recent examples from the literature can be seen in several fields.In the medical field,WSNs can be used to monitor patient conditions at home, making it easier to take emergency actions and saving time.In order to provide security,surveillance networks can be deployed,also making it possible to collaboratively recognize targets.In industry,WSNs enhance the efficiency of processes by allowing timely fault correction. To regain their strength a modulation should be needed which increase its strength. So to overcome this problem a novel technique will be proposed which is based upon adaptive modulation. Adaptive modulation helps to increase signal strength and reduce energy consumption.

1.1 Wireless Sensor Networks(WSNs)

A wireless sensor network is a group of specialized transducers with a communications infrastructure for monitoring and recording conditions at diverse locations. Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, illumination intensity, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels and vital body functions.

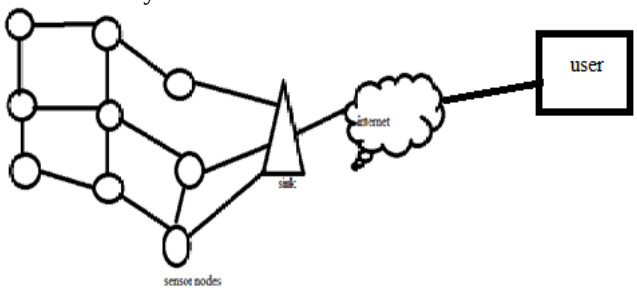

Fig.-1

A sensor network consists of multiple detection stations called sensor nodes, each of which is small, lightweight and portable. Every sensor node is equipped with a transducer, microcomputer, transceiver and power source. The transducer generates electrical signals based on sensed physical effects and phenomena. The microcomputer processes and stores the sensor output. The transceiver receives commands from a central computer and transmits data to that computer. The power for each sensor node is derived from a batterIf the node is not able to communicate with other through direct link i.e. they are out of coverage area of each other and the data can be send to the other mode by using the nodes in between them.This property is referred as multi-hoping [5].

1.2 Wireless Sensor Networks Have The Following Characteristics [2]

- The sensor nodes are organized into a group is called cluster. Cluster head perform data aggregation and BS receives compressed data.

- The lifetime of wireless sensor network is the total amount of time before the first sensor node runs out of power.
- All sensor nodes use the direct transmission or multi-hop transmission to communicate with the base stationbecause all sensor nodes are immobile.
- Sensor nodes sense conditions at different locations at a fixed rate and always have data to send to the base station.
- Sensor nodes can revise the transmission power of wireless transmitter according to the distance.

1.3 Classification Of Wireless Sensor Networks

The classification is based on functionality and characteristics of the sensor nodes in wireless sensor networks there are two types of wireless sensor networks:

1.3.1 In Heterogeneous Sensor Networks

Heterogeneous wireless sensor network (heterogeneous WSN) consists of sensor nodes with different ability, such as different computing power and sensing range. Compared with homogeneous WSN, deployment and topology control are more complex in heterogeneous WSN. In this paper, a deployment and topology control method is presented for heterogeneous sensor nodes with different communication and sensing range. It is based on the irregular sensor model used to approximate the behavior of sensor nodes. Besides, a cost model is proposed to evaluate the deployment cost of heterogeneous WSN. According to experiment results, the proposed method can achieve higher coverage rate and lower deployment cost for the same deployable sensor nodes.

1.3.2 In Homogeneous Sensor Networks

A **wireless sensor** network is said to be **homogeneous** if all of it **sensor**s have the same storage, processing, battery power, sensing, and communication capabilities.To gain more flexibility and fast execution convergence of the number of nodes in wireless sensor network in homogeneous sensor networks had done by distributed cluster head election and formation process of cluster is most appropriate approach . There are also a few approaches using hybrid techniques or centralized where one or more coordinator nodes or the BS is responsible to partition the whole network off-line and control the cluster membership. They are naturally not suitable for general-purpose large-scale WSNs applications they may be suitable only for special purpose limited-scale applications where network partitioning and network partitioning is required [6].

1.4 Challenges In WSNs

The sensor networks have a many technical challenges due to some factors as given

Ad-Hoc Deployment

In sensor nodes, Most of sensor nodes are deployed in regions which have no infrastructure at all. A typical way of deployment in a forest would be tossing the sensor nodes from a aeroplane [11].

Dynamic Changes

Sensor network's nature is dynamic. The sensor nodes are configurable itself. Sensor nodes are easily adopting by changes in the sensor network due to addition of more sensor nodes in the network and failure of any node.

Fault Tolerance

The fault tolerance means that to maintain the infrastructure in a form that if one node dies then it cannot affect the other nodes.The adaptive protocols are developed to maintain the other network unaffected [8].

Issues Of Security

Most of the attacks and threats against security in wireless networks are almost identical to their wired counterparts while some are exacerbated with the inclusion of wireless connectivity. In fact, wireless networks are usually more vulnerable to various security threats as these unguided transmission medium is more susceptible to security attacks than those of the guided transmission medium.

Energy Consumption

The energy consumption is a big challenge in wireless sensor networks.The sensor nodes are small in size and equipped with a limited number of power source.The sensor nodes are dependent on the battery which are very hard to replace due to the physical constraints.Due to this reason many of researchers are concentrating on the design of power aware protocols and algorithms.Limited process or bandwidth and small memory are two arguable constraints in sensor networks ,which will disappear with the development of fabrication techniques .However,the energy constraint is unlikely to be solved soon due to slow progress in developing battery capacity. The untended nature of sensor nodes and hazardous sensing environments preclude battery replacement as a feasible solution. It is a very important research issue to provide a form of energy efficient surveillance service for a geographic area.

1.5 CSMA/CA

Carrier sense multiple access with collision avoidance (CSMA/CA), in computer networking, is a wireless network multiple access method in which:a carrier sensing scheme is used.a node wishing to transmit data has to first

listen to the channel for a predetermined amount of time to determine whether or not another node is transmitting on the channel within the wireless range. If the channel is sensed "idle," then the node is permitted to begin the transmission process. If the channel is sensed as "busy," the node defers its transmission for a random period of time. Once the transmission process begins, it is still possible for the actual transmission of application data to not occure. CSMA/CA is a modification of carrier sense multiple access.Collision avoidance is used to improve CSMA performance by not allowing wireless transmission of a node if another node is transmitting, thus reducing the probability of collision due to the use of a random truncated binary exponential back off time.Optionally, but almost always implemented, an IEEE 802.11 RTS/CTS exchange can be required to better handle situations such as the hidden node problem in wireless networking. The use of collision avoidance is used to improve the performance of CSMA by attempting to divide the wireless channel up somewhat equally among all transmitting nodes within the collision domain. CSMA/CA differs from CSMA/CD due to the nature of the medium, the radio frequency spectrum. Collisions cannot be detected while occurring at the sending node, thus it is vital for CSMA/CA or another access method to be implemented. CSMA/CA is used in 802.11 based wireless LANs and other wired and wireless communication systems. One of the problems of wireless data communications is that it is not possible to listen while sending, therefore collision detection is not possible. Another reason is the hidden terminal problem, whereby a node A, in range of the receiver R, is not in range of the sender S, and therefore cannot know that S is transmitting to R.

II. LITERATURE SURVEY

Lucas D. P. Mendes et al., "Lifetime Analysis of a Slotted ALOHA-based Wireless Sensor Network using a Cross-layer Frame Rate Adaptation Scheme", IEEE, 2012

In this paper [1] they introduced to improve the network lifetime in wireless sensor network cross-layer design has been widely used. In this paper, they discussed a cross-layer solution is combined to a transmission advertisement scheme to improve a small slotted ALOHA based wireless sensor network throughput and lifetime. To reduced transmission overhead compared to other medium access methods this medium access method scheme has been chosen because it does not add protocol information to be transmitted with data bits. The results shows that, the combination of a cross-layer design and the advertisement scheme has proven to increase the network throughput by more than 10% and to double the network lifetime when compared to a slotted ALOHA wireless sensor network without advertisements.

E.Ilker Oyman and Cem Ersoy, "Multiple Sink Network Design Problem in Large Scale Wireless Sensor Networks", IJCA, 2010.

In this paper [2] they discussed in wireless sensor networks the battery life of the nodes should be managed efficiently so the lifetime of the network is increased. In large scale networks they consider large number of sensor nodes and multiple sink nodes deployed for increase the manageability of the network and reduce the energy consumption. In this paper they mainly focus on the multiple sink location problems in large scale wireless sensor networks. Different problems are depends upon the design criteria. They consider locating sink nodes to the sensor environment, where we are given a time constraint that states the minimum required operational time for the sensor network.

Katayoun Sohrabi et al., "Protocols for Self-Organization of a Wireless Sensor Network", IJSER, 2011

In this paper [3] they presented algorithms for wireless sensor networks, which is self-organized networks, in this larger number of static nodes with highly constrained energy resources. In wireless sensor networks some protocols which supported the slow mobility by a subset of the nodes, energy efficient routing, and formation of sensor networks for carrying out cooperative signal processing functions among a set of the nodes. Wireless sensor networks used for such applications as surveillance, widespread environmental sampling, security and health monitoring [11].

Yu Cheng et alWireless Mesh Network Capacity Achievable Over the CSMA/CA MAC", IEEE, 2012

In this paper [4] they presented a theoretical analysis of the maximum throughput of a wireless mesh backhaul network that is achievable over a practical carrier sense multiple access with collision avoidance (CSMA/CA) medium access control (MAC) protocol. They resort to the multi commodity flow (MCF) formulation augmented with the conflict-graph constraints, a novel approach to take into account the collision overhead in the distributed CSMA/CAMAC. Such overhead due to random access has been ignored by existing MCF-based capacity studies, which assume impractical centralized scheduling and result in aggressive capacity planning, which is unachievable over the CSMA/CA MAC.

This paper makes the following three main contributions: 1) They developed a generic method of integrating the CSMA/CA MAC analysis with the MCF formulation for optimal network capacity analysis, which readily generates an upper bound of the network throughput; 2) Authors define a new concept of CSMA/CA clique and theoretically study its relationship to a CSMA/CA area in terms of throughput; and 3) using the CSMA/CA clique as a tool, they derive a lower bound of the network throughput achievable over the CSMA/CA MAC by clique-based MCF formulation. NS-2 simulation results are presented to demonstrate the tightness of the upper and lower bounds that are newly developed, compared to those based on the MCF formulation assuming a slotted system and centralized scheduling.

Imad S. Alshawi, et al, "Lifetime Enhancement In Wireless Sensor Networks Using Fuzzy Approach and A-Star Algorithm", IJCA, 2012.

In this paper [5] they proposed a new routing method for WSNs to extend network lifetime using a combination of a fuzzy approach and an A-star algorithm .The proposal is to determine an optimal routing path from the source to the

destination by favoring the highest remaining battery power, minimum number of hops, and minimum traffic loads. To demonstrate the effectiveness of the proposed method in terms of balancing energy consumption and maximization of network lifetime, they compare their approach with the A-star search algorithm and fuzzy approach using the same routing criteria in two different topographical areas.

Ossama Younisand Sonia Fahmy Distributed Clustering In Ad-hoc Sensor Networks: A Hybrid, Energy-Efficient Approach", ACM , 2012

In this paper [6] they discussed that topology control in a sensor network balances load on sensor nodes,and increases networks ability and lifetime. In sensor network clustering of sensor nodes is an effective topology. In this paper,they proposed a distributed clustering approach for long-lived ad-hoc sensor networks.Proposed approach does not make any assumptions about the presence of infrastructure or about node capabilities,other than the availability of multiple power levels in sensor nodes. They presented a protocol,HEED(Hybrid Energy-Efficient Distributed clustering),that periodically selects cluster heads according to a hybrid of the node residual energy and a secondary parameter,such as node proximity to its neighborsor node degree.HEED terminates in (1) iterations,in slow message overhead,and achieves fairly uniform cluster head distribution across the network.

Ming Zhang and Suoping Wang, "A Novel Energy-Efficient MAC Protocol based on Collision Avoidance for Wireless Sensor Networks", 2009 IEEE.

In this paper [7] they summarized the design paradigms of the MAC protocol in wireless sensor networks, then based on ring topology based on virtual grid and token ring ideas, an novel energy-efficient MAC protocol based on collision avoidance (EECA-MAC) for wireless sensor networks was proposed. Comparing with other algorithms, it was founded that EECA-MAC has two obvious features: Firstly, it improves energy utility by changing the activity of wireless communication module of sensor nodes, energy model and state transition of sensor nodes. Secondly, EECA-MAC adopts ring topology based on virtual grid intra cluster and time slot ideas to avoid collision. Simulation results showed that, compared with TDMA and SMAC, EECA-MAC significantly reduce in energy consumption and prolong the network lifetime.

III. PRESENT WORK

3.1 Problem Formulation

The wireless sensor node, being a microelectronic device, can only be equipped with a limited energy. In some applications cenarios,there charge or replacement of energy resources might be impossible.Sensor node life time shows a strong dependence on battery lifetime.If the sensor nodes may get die due to limited battery then the chances of network breakage increases and if we want to collect the data (temperature, humidity etc) of that particular area we cannot get that data.Also,in a multi hocpad-hocsensor network,each node plays the dual role of data origin at or and data router.The malfunctioning of a few nodes can cause significant topological changes and might require rerouting of packet sand reorganization of the network. Hence,energy conservation takes on additional importance. Many techniques are proposed for energy saving,Clustering is one of them.In this technique, the clusters are formed by clustering of the grouping nodes. The cluster heads are elected periodically such that members of a cluster can communicate with their cluster heads.These cluster heads send data received from its members to a base station.The multi clustering can also be used.The cluster heads should have to be rotated for the balancing of energy and then there will be equal load on every node.The energy consumption can be reduced.

In the present work the whole network is distributed in clusters.The cluster heads can communicate to each other by using the Destination Sequenced Distance Vector (DSDV) routing algorithm.All the members of the cluster give their data to the cluster head and cluster head for ward it to the other cluster head until the data do not reach its destination.In the whole network the path between cluster heads is fixed. The path cannot be changed until all the sensor nodes do not die means their battery goes to down.In this case some intermediate nodes will die earlier than other nodes.Then the path is breakdown between source and destination.Here due to path breakage the packet loss increases,the packet do not reach at the destination. Packet retransmission is also increases the whole network becomes useless.A new network is configured for complete the communication.To configure the new network again become the clusters and cluster heads it takes too much time and consume energy may be the network do not complete the communication.

The CSMA/CA is the protocol which is used for the channel sensing in the wireless networks. As, the mobile ad hoc networks is the self configuring type of network in which the mobile nodes can leave or join the network when they want, In such type of network clocks of mobile devices are not synchronized which reduced the efficiency of the CSMA/CA. The overall networks throughput will be reduce and end to end delay will be increased as due to the reduction in the efficiency of the CSMA/CA packet collision will be there in the network. In the present work the sensor nodes are not synchronous to each other.The packet collision occurs due to the mismatch of timing.Again the packet loss and packets do not reach to their destination. In this concept,here two nodes are the source and two destination,they followed the same path for data transfer.Cluster1's source send the data to cluster4's destination and cluster3's source send the data to cluster2's destination.Here the clock synchronous is not present between the mobile nodes.

To solve the problem of clock synchronize in wireless sensor networks, the scheme of adaptive packets has been used. In this scheme, the wireless nodes will use the adaptive packets to take the channel access. The main problem exists in such scheme is when the adaptive packets collide with each other. The wireless sensor nodes keep on waiting without any reason. This will reduce the network efficiencyand reliability.

3.2 Objectives

Following are the various objectives of this research work:

1. To enhance and implement the enhancement in the Adaptive packet scheme.
2. To increase the reliability of the MANET by enhanced Adaptive packet scheme
3. To increase the reliability in the data transmission.
4. To maintain the high clock synchronization between the mobile nodes to reduce packet loss.

3.3 Research Methodology

Firstly we deploy the sensor network with infinite sensor nodes. All the sensor nodes are grouped in to clusters.According to the sensor nodes these clusters are formed.Each cluster has a cluster head.Cluster heads arec hooses by election algorithm.A node in a cluster which has more resources and energy is selected for cluster head. cluster heads and cluster heads forward the data to their respective destinations. For transmission,route is discovered by AODV routing protocol.The path is established between source and destination. AODV routing protocol discover the virtual paths means dynamic paths. After the path discovered the transmission takeplace. All the sensor nodes should be synchronized to avoid the packet collision. A master node is deployed with in sensor network that is synchronized with GPS.Master node gives the timing information to all sensor nodes so they all are synchronized to each other. The adaptive packet collision will be removed with the use of acknowledgment packets. The adaptive packet when received by the end node, it will send an acknowledgment to the sender. This will reduce the unknown wait and enhance the network efficiency and reliability.

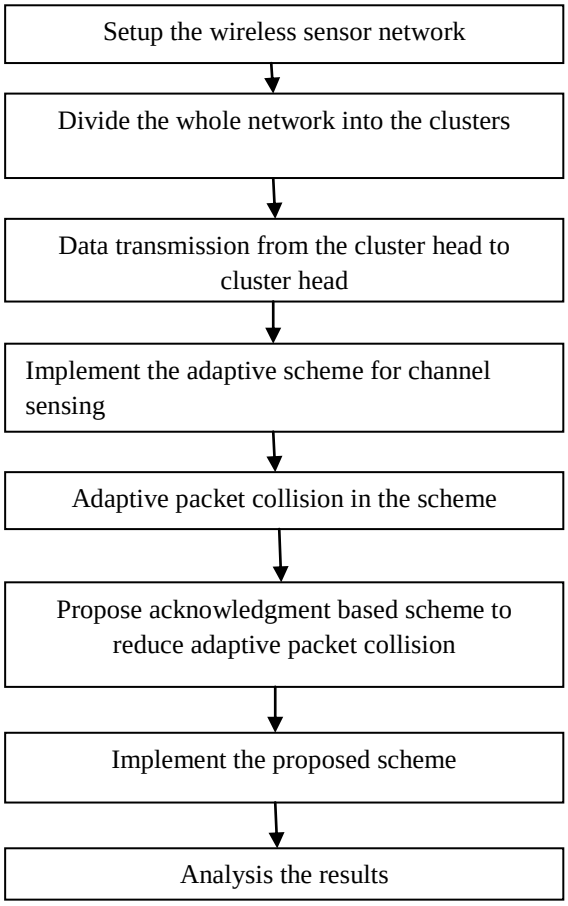

Fig.-3.3

IV. TOOL

The Network Simulator-2 (NS-2) is an open-source simulation tool running on Unix-like operating system. It is a discrete event simulator targeted at networking research and provides substantial support for simulation of routing, multicast protocols and IP protocols, such as UDP, TCP, RTP and SRM over wired, wireless and satellite networks. It has many advantages that make it a useful tool, such as support for multiple protocols and the capability of graphically detailing network traffic. Additionally, network simulator-2 supports several algorithms in routing and queuing. LAN routing and broadcasts are part of routing algorithms. Queuing algorithm includes fair queuing, deficit round robin and FIFO. The network simulator-2 started as a variant of the REAL network simulator in 1989. REAL is a network simulator originally intended for studying the dynamic behavior of flow and congestion control schemes in packet-switched data Networks. In 1995 ns development was supported by Defense Advanced Research Projects Agency DARPA through the VINT project at LBL, Xerox PARC, UCB, and USC/ISI. The wireless codes from the UCB Daedelus and CMU Monarch projects and Sun Microsystems have added the wireless capabilities to NS-2.

The network simulator (NS), which is a discrete event simulator for networks, is a simulated program developed by VINT (Virtual Internetwork Test-bed) project group. It supports simulations of TCP and UDP, some of MAC layer protocols, various routing and multicast protocols over both wired and wireless network etc.

Depending on user's requirement the simulation are stored in trace files, which can be fed as input for analysis by different component:

1. A NAM trace file (.nam) is used for the ns animator to produce the simulated environment.
2. A trace file (.tr) is used to generate the graphical results with the help of a component called X Graph.

REFERENCES

[1] Lucas D. P. Mendes, Joel J. P. C. Rodrigues∗ , Athanasios V. Vasilakos , and Liang Zhou "Lifetime Analysis of a Slotted ALOHA-based Wireless Sensor Network using a Cross-layer Frame Rate Adaptation Scheme".

[2] E. Ilker Oyman and Cem Ersoy, "Multiple Sink Network Design Problem in Large Scale Wireless Sensor Networks" IEEE, 2011

[3] Katayoun Sohrabi, Jay Gao, Vishal Ailawadhi and Gregory J Pottie, "Protocols for Self-Organization of a Wireless Sensor Network", IJSER, volume 3, issue 7, 2011

[4] Yu Cheng, Hongkun Li, Peng-jun Wan, Xinbing Wang "Wireless Mesh Network Capacity Achievable Over the CSMA/CA MAC", IEEE Transaction on Vehicular Technology, September 2012.

[5] K.Ramesh and Dr. K.Somasundaram "A Comparative Study of Cluster-Head Selection Algorithms in Wireless Sensor Networks" International Journal of Computer Science & Engineering Survey (IJCSES) November 2011.

[6] Ossama Younisand Sonia Fahmy, "Hex-MASCLE – Hexagon based Clustering withSelfHealing Abilities", *IEEE, 2012*

[7] Ming Zhang and Suoping Wang, "A Novel Energy-Efficient MAC Protocol based on Collision Avoidance for Wireless Sensor Networks", IEEE, 2009, pp 344-308

[8] Changsu Suh and Young-Bae Ko, "A Traffic Aware, Energy Efficient MAC Protocol for Wireless Sensor Networks", IEEE, 2005

[9] Ms. Sunita el al." Comprehensive Study of Applications of Wireless Sensor Network" *International Journal of Advanced Research in Computer Science and Software Engineering 2 (11), November- 2012, pp. 56-60*

[10] Sudhanshu Pant, Naveen Chauhan "Effective Cache based Policies in Wireless Sensor Networks: A Survey" International Journal of Computer Applications (0975 – 8887)

[11] Basilis Mamalis, Damianos Gavalas, Charalampos Konstantopoulos and Grammati Pantziou,"Clustering in Wireless Sensor Networks",2009.

[12] Archana Bharathidasan, Vijay Anand Sai Ponduru "Sensor Networks: An Overview"

[13] I.F.Akyildiz,W.Su*,Y.Sankarasubramaniam, E.Cayirci, "WirelessSensorNetworks:ASurvey Broadband And Wireless Networking Laboratory, School of Electrical and Computer Engineering, Georgiainstituteof Technology,Atlanta,GA 30332,USAReceived12December2001; accepted20 December2001.

[14] Jakob Salzmann,Ralf Behnke,DirkTimmermann"Hex-MASCLE–Hexagonbased Clustering withSelfHealing Abilities",WirelessCommunicationsandNetworking Conference (WCNC), pp. 528-533,2011IEEE.

[15] Jia Xu, Ning Jin, Xizhong Lou, Ting Peng, Qian Zhou, YanminChen, "Improvement of LEACHprotocolforWSN"InternationalConference on Fuzzy Systems and Knowledge discovery(FSKD)", pp. 2174-2177, 2012IEEE.

