International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 3 Issue 7, July 2014

Improved QoS Optimization Approach in Sensor Network using Convolutional Encoding

Yashu[1], Smita[2]
[1]M.Tech student, CSE Dept., PDM College of Engineering for Women
[2]Assistant Professor, PDM College of Engineering for Women

***Abstract*: wireless sensor network is composed of nodes that communicate over wireless links without the need for any central control or fixed infrastructure address. One of the common problem in wireless sensor network is to provide optimized QoS. To achieve the QoS, the energy is the critical vector. In congested network, the energy vector becomes more critical and there is the requirement to provide effective solution in energy effective communication network. In this paper, an effective encoding scheme is suggested to reduce the network load by reducing the size of data packet communicating over the network so that effective network communication can be performed.**

***Keywords*: WSN, QoS, convolution encoding, network lifetime.**

I. INTRODUCTION

Wireless Sensor Networks (WSNs) have emerged as research areas with an overwhelming effect on practical application which are very much important for the development. They permit fine grain observation of the ambient environment at an economical cost much lower than currently possible. In hostile environments, where human participation may be too dangerous sensor networks may provide a robust service and can help in collecting large amount of data. Sensor networks are designed to transmit data from an array of sensor nodes to a data repository on a server which will display the result to the user. The advances in the integration of micro-electro-mechanical system (MEMS), microprocessor and wireless communication technology have enabled the deployment of large-scale wireless sensor networks. WSN has potential to design many new applications for handling emergency, military and disaster relief operations that requires real time information for efficient coordination and planning. The sensor nodes consist of sensing, data processing and communicating components. They can be used for continuous sensing, event detection as well as identification, location sensing and control of actuators. The nodes are deployed either inside the phenomenon or very close to it and can be operated unattended. They can use their processing abilities to locally carry out simple computations and transmit only required and partially processed data. They may be organized into clusters or collaborate together to complete a task that is issued by the users. In addition, positions of these nodes do not need to be predefined. These allow their random deployment in inaccessible terrains or disaster relief operations. The WSN provides an intelligent platform to gather and analyze data without human intervention. As a result, WSNs have a wide range of applications such as military applications, to detect and track hostile objects in a battle field or in environmental research applications, to monitor a disaster as seismic tremor, a tornado or a flood or for industrial applications, to guide and diagnose robots or machines in a factory or for educational applications, to monitor developmental childhood or to create a problem solving environment.

The paper is organized as follows. Section II of this paper includes the related work done by various authors in this field. Section III includes the proposed technique in detail. Experiment design for the simulation is present in section IV. The work is concluded in section V.

II. RELATED WORK

In year 2006, Juejia Zhou performed a work," A Kind of Application-Specific QoS Control in Wireless Sensor Networks". In the paper, Author defines the optimal number of power-up nodes in the focused area as the QoS target. In order to make the optimal number of nodes to power up in the focused area, a modified Gur Game strategy is given. In year 2007, Haifeng Hu performed a work, "The Study of Power Control Based Cooperative Opportunistic Routing in Wireless Sensor Networks". This paper presents PC-CORP (Power Control based Cooperative Opportunistic Routing Protocol) for WSN (Wireless Sensor Networks), providing robustness to the random variations in network connectivity while ensuring better data's forwarding efficiency in an energy efficient manner. Based on realistic radio model, Author combine the region-based routing, rendezvous scheme, sleep discipline and cooperative communication to model data forwarding by cross layer design in WSN. In year 2009, Peng Ji performed a work," A Power-aware Layering Optimization Scheme for Wireless Sensor Network". In the scheme, a directed spanning tree routing algorithm is discussed to resolve unnecessary energy consumption during data transmission. Regarded as a key factor, transmission power of node should be controlled to avoid occurrence of communication contention in some hot sub-area. And a Lagrange dual function is designed and iterated in order to find the optimal transmission power of every sensor node. In year 2011, Djamel Djenouri performed a work," Traffic-Differentiation-Based Modular QoS Localized Routing for Wireless Sensor Networks". The proposed protocol can operate with any medium access control (MAC) protocol, provided that it employs an acknowledgment (ACK) mechanism. Extensive simulation study with scenarios of 900 nodes shows the proposed protocol outperforms all

ISSN: 2278 – 1323

comparable state-of-the-art QoS and localized routing protocols. In year 2013, Mohammad Arifuzzaman performed a work," An Intelligent Hybrid MAC with Traffic-Differentiation-Based QoS for Wireless Sensor Networks". In this paper, Author presents the Intelligent Hybrid MAC (IH-MAC), a novel low power with quality of service guaranteed medium access control protocol for wireless sensor networks (WSNs).

III. IMPROVED QoS OPTIMIZATION APPROACH

A sensor network is a network with large number of sensors. Each sensor node is defined with some energy parameters. With each communication over the network some amount of energy is lost. In such network if some nodes perform the flooding or any kind of extra communication, the network suffers a lot. In sensor network DOS attack not only delay the communication but also great loss of energy over the network. In this section, an encoding mechanism is suggested to reduce the communication over the network. As the data packet size is reduced, the energy consumption will also be reduced and the network throughput and network life will be improved. The work is divided in two stages. In first stage, the network communication is performed using aggregative communication approach. In second stage, the size of data packets is reduced by using convolution encoding mechanism.

Ist STAGE: In first stage the broadcast communication is converted to aggregative path communication so that congestion over the network can be reduced. The aggregative path generation is defined here under different parameters.

Analyzing Parameters**:**

A) Throughput Analysis

The throughput is here defined in terms of successful data transmission over a node. To estimate the throughput, the capacity of a node along with the load is analyzed and based on these parameters. To analyze the throughput, the sensor capacity analysis is performed. The capacity parameter is based on the energy level, sensing range analysis and the load over a node is defined. Along with throughput analysis, effective throughput and the idle rate are analyzed. The effective throughput defines the maximum throughput that can be achieved and based on these factors the ideal throughput is estimated for the communication, represented by equation given under. If the communication is more than the ideal throughput, the neighbor is eligible for the next hop selection.

ICapacity(Node(i)) = EffectiveThroughput(Node(i)) – CurrentThroughput(Node(i))

And the throughput analysis is based on the distance vector and the load over a node.

Effective Throughput(node(i)) = Distance*Transmission Rate – Distance*Transmission Rate*OverheadLoss

Here the distance is the communication distance to the next hop. The transmission rate is the rate of data transmission and the overhead loss is the predictive loss because of the node's random movement.

Current Throughput(Node(i)) =
(Distance*Congestion(Node(i))*Transmission) +
(Distance*(1-Congestion(Node(i)) *Transmission) -
(Distance*(1-Congestion(Node(i))*Transmission*Overhead loss)

The current throughput also takes the current load vector to identify the probability of communication failure. Higher the congestion vector, lesser the throughput will be obtained.

B) Energy Analysis

The energy is the main constraint for any sensor network. Each node in the network is defined with specific energy parameter (E). As the communication is performed, each participating node consumes some amount of energy. Some parameters are given in table 1.

Table 1: Energy Parameters

Parameter	Energy
Energy (E)	1 J
Transmission Energy (Te)	5 nJ
Receiving Energy (Re)	5 nJ
Forwarding Energy (Fe)	1 nJ

The amount of energy consumed under the specifications defined in table 1 is given as

Energy Consumed = TransmissionEnergy(A) + Receiving Energy(B) + Forwarding Energy(C) +Forwarding Energy(D)

EnergyConsumed = 50 nJ + 50 nJ + 10 nJ + 10 nJ
= 120 nJ

Total energy consumed in this vector is 120 nJ.

C) Load Analysis

As the traffic over a node is increased, the load or the congestion will be increased. The overload conditions always slow down the communication as well as give the higher data loss. The load analysis over the network is the reliability parameter to estimate the criticality of the communication. The load is directly proportional to the network reliability. Lesser the congestion, reliable the network will be = Congestion α Reliability

2nd STAGE: In second phase, to reduce the network load, the encoding mechanism is suggested to improve the network life.

CONVOLUTIONAL ENCODING

In the convolution codes, the block of n bits generated by the encoder in a time slot depends not only on the k message bits within that time slot, but also on the preceding 'L' blocks of message bits (L>1).

Convolution Code Encoder:

ISSN: 2278 – 1323

The fundamental hardware unit of the convolution encoding is a taped shift register with (L+1) stages, as shown in figure 1. Here, g_0, g_1…..etc are the tap gains which are nothing but binary digits 0s or 1s. A tap gain 0 represents an open circuit whereas a tap gain of 1 represents a short circuit.

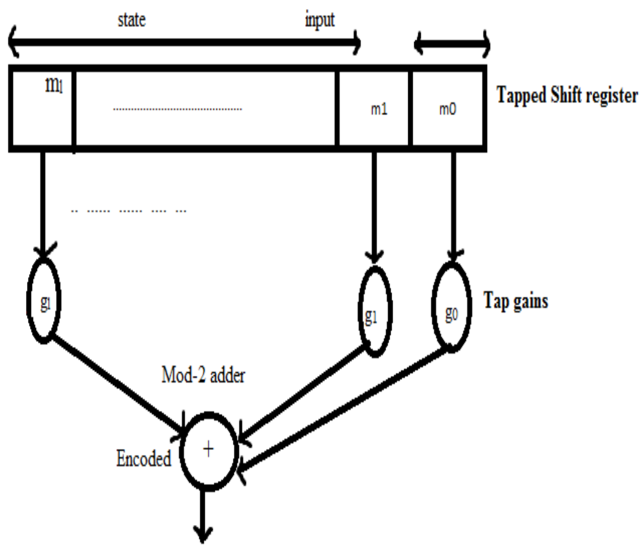

Figure1 Block diagram of a convolution encoder

Encoder Parameters:
Convolutional codes are primarily described by three parameters (n, k, m) where,
n = number of output bits
k = number of input bits
m = number of memory registers
A convolutional encoder is characterized by two parameters, namely code rate (r) and constraint length (K).
The code rate is defined as the ratio of the number of message bits(k) to the number of encoded bits (n).

$$r = k/n$$

IV. RESULTS & DISCUSSION

To calculate the impact of proposed approach, simulation is done using MATLAB. The result refers to the measurement of network life time. Life time of network is related to number of alive nodes, number of dead nodes, and rate of packet transmission and how long time cluster of nodes is formed in network. System which is proposed here gives good output in all four parameters. We have taken all these values and find that there are less dead nodes and more alive nodes in proposed system. Also rate of packet transmission is enhanced and due to more alive nodes cluster formation process is ensure for a long time which tends to increase life time of wireless sensor network. The comparison is here performed with standard chain based protocol. Common parameters used in our proposed approach and in existing approach are shown in table 2.

Table2. Proposed vs Existing approach parameters

PROPOSED APPROACH		EXISTING APPROACH	
Parameter	Value	Parameter	Value
Number of Nodes	100	Number of Nodes	100
Probability of Selection	.1	Probability of Selection	.1
Energy	0.5	Energy	0.5
Transmission Energy	50*0.000000001	Transmission Energy	50*0.000000001
Receiving Energy	50*0.000000001	Receiving Energy	50*0.000000001
Forwarding Energy	10*0.000000001	Forwarding Energy	10*0.000000001
Topology	Random	Topology	Random
Encoding	Convolutional Code	Encoding	No
Packet Size	Reduced Encoded	Packet Size	4000 Bytes

Under above discussed parameters the obtained results are given as below. Here figure 2 is showing the network life in terms of dead node estimation. As we can see x axis here represents the number or rounds and y axis represents the dead nodes. The presented approach has improved the network life by reducing the energy consumption over the network. Figure 3 is representing the same analysis for the alive nodes over the network. As we can see there are about 2 nodes left alive after 3000 rounds in case of existing work and around 8 nodes left alive after the proposed approach. We can see the more number of nodes are dead after 3000 rounds in case of existing work protocol.

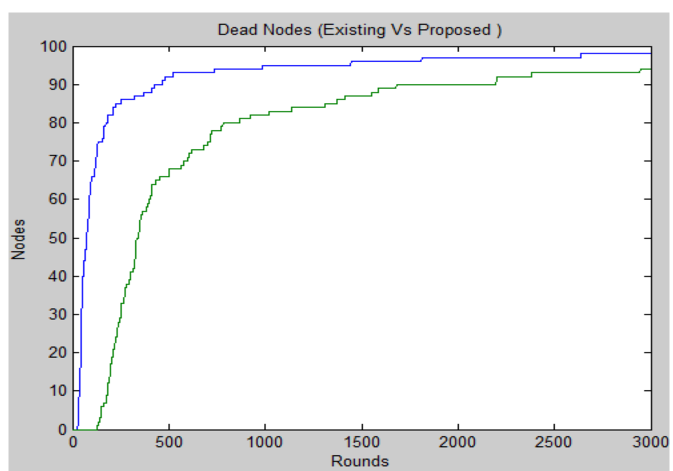

Figure 2: Dead Node Analysis (Existing Vs. Proposed)

ISSN: 2278 – 1323

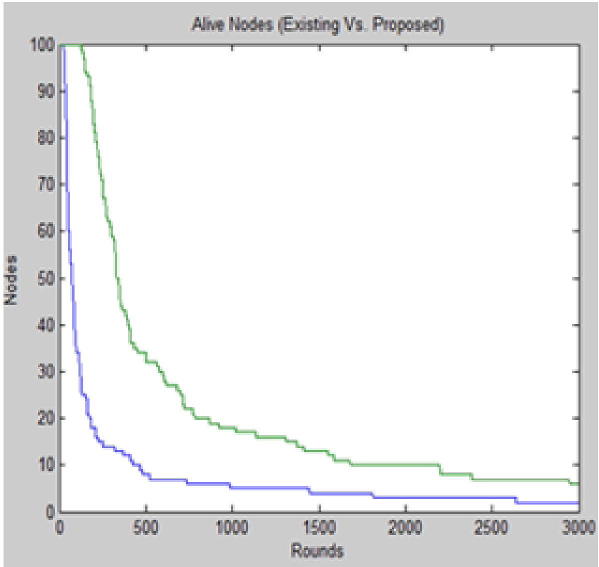

Figure 3: Alive Node Analysis

As we can see, the presented approach is also effective in terms of energy consumption as compared to existing approach.

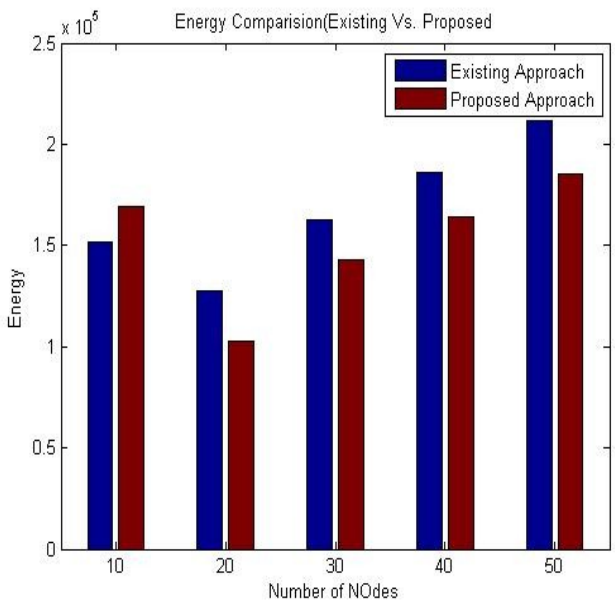

Figure 4: Energy Analysis (Existing Vs. Proposed)

In figure 5, the X-Axis represents the Error in the channel and Y axis represents the probability of detection of error. As we can see the detection chances of error is same and somewhat decrease in case of existing approach but the proposed system gives the better ratio of error detection chances.

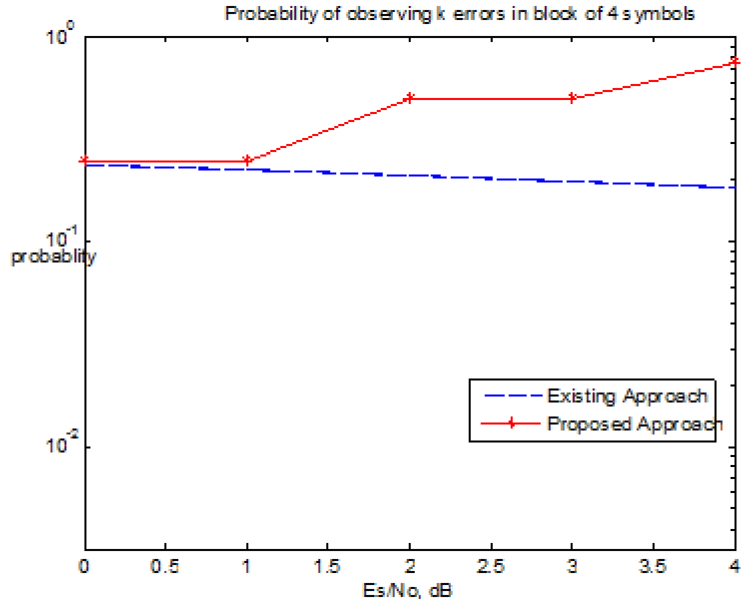

Figure 5: Probability of Error Detection in 4 Symbols System (Existing Vs. Proposed)

V. CONCLUSION

The presented approach is focused on one of major problem of sensor network called QoS. In sensor network, most of the communication is performed in the form of multi cast and broadcast communication. In such kind of communication, the load over the network increased so that it can cause some data loss. In this paper, a neighbor node analysis approach is defined to perform the bandwidth utilization over the network. We have defined a broadcast communication over the network with single source and set all other nodes as destination node. The presented approach is divided in two phases. In first phase, the broadcast communication is converted to aggregative path communication so that congestion over the network will be reduced. The aggregative path generation is defined under different parameters. In second phase, to reduce the network load, the encoding mechanism is suggested to improve the network life. Modified system output shows improvement in four areas.

1. There is less number of dead nodes.
2. Number of alive nodes is enhanced.
3. Packet transmission to base station occurs frequently.
4. Even in last round clustering process is going take place.

VI. REFERENCES

[1] Juejia Zhou," A Kind of Application-Specific QoS Control in Wireless Sensor Networks", Proceedings of the 2006 IEEE International Conference on Information Acquisition 1-4244-0529-7/06©C2006 IEEE

[2] Haifeng Hu, "The Study Of Power Control Based Cooperative Opportunistic Routing In Wireless Sensor Networks", Proceedings of 2007 International Symposium on

ISSN: 2278 – 1323

Intelligent Signal Processing and Communication Systems 1-4244-1447-4/07 ©2007 IEEE

[3] Paulo Sergio Sausen," Energy Efficient Blind Flooding in Wireless Sensors Networks".

[4] Peng Ji," A Power-aware Layering Optimization Scheme for Wireless Sensor Network", 978-1-4244-3693-4/09 ©2009 IEEE

[5] Parvaneh Rezayat," A Novel Real-Time Routing Protocol in Wireless Sensor Networks", 978-1-4244-5757-1/10 ©20091EEE

[6] Kritchai Witheephanich," On The Applicability of Model Predictive Power Control to an IEEE 802.15.4 Wireless Sensor Network", ISSC 2009.

[7] Djamel Djenouri," Traffic-Differentiation-Based Modular QoS Localized Routing for Wireless Sensor Networks", IEEE TRANSACTIONS ON MOBILE COMPUTING 1536-1233/11@ 2011 IEEE

[8] A. Chehri," QoS Aware Green Routing Protocol for Wireless Sensor Networks", 2012 25th IEEE Canadian Conference on Electrical and Computer Engineering (CCECE) 978-1-4673-1433-6/12 ©2012 IEEE

[9] Prof. Arun Biradar," Dual Channel Based Multi-Objectives Genetic Routing Protocol for Ad-Hoc Networks and Optical Networks Using Power Aware Clustered Topology", 2012 International Conference on Optical Engineering (ICOE) 978-1-4673-2463-2/12 © 2012 IEEE

[10] Nirmala.S, Nallusamy.R, "An Energy-Efficient and enhanced QoS aware of MAC application specific protocol in the distributed Wireless Sensor Networks", IEEE- Fourth International Conference on Advanced Computing, ICoAC 2012 MIT, Anna University 978-1-4673-5584-1/12@2012 IEEE

[11] Mohammad Arifuzzaman," An Intelligent Hybrid MAC With Traffic-Differentiation-Based QoS for Wireless Sensor Networks", IEEE SENSORS JOURNAL 1530-437X © 2013 IEEE

[12] Diogo F. Lima Filho," TCNet: Trellis Coded Network - implementation of QoS-aware routing protocols in WSNs".

[13] D. F. L. Filho," TCNet: Trellis Coded Network – Implementation of QoS-aware Routing Protocols in WSNs", IEEE LATIN AMERICA TRANSACTIONS

[14] Irfan Al-Anbagi," An Adaptive QoS Scheme for WSN-based Smart Grid Monitoring", IEEE International Conference on Communications 2013: IEEE ICC'13 - 3rd IEEE International Workshop on Smart Communication Protocols and Algorithms (SCPA 2013) 978-1-4673-5753-1/13 ©2013 IEEE

[15] Luıs Marques," Fighting Uncertainty in Highly Dynamic Wireless Sensor Networks with Probabilistic Models", 2013 IEEE 32nd International Symposium on Reliable Distributed Systems 1060-9857/13© 2013 IEEE

ISSN: 2278 – 1323