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Adaptive Range Control Scheme to Improve QoS for WSNs

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Abstract: ***In wireless sensor networks (WSNs), economical power utilization is crucial analysis drawback since from last twenty years. The WSNs are cluster of energy strained and little sensing element nodes. Since from the emerge of WSN mechanism, researchers conferred numerous ways to enhance the network period of time supported completely different layers like routing protocol, mac (Medium Access Control) protocols etc. except for this the transmission range parameter that is by default fixed in WSNs also can facilitate to reduce the overall power consumption. In this paper, we proposed Adaptively Transmission Range & Minimization of Energy (ATREM) algorithm utilization of the energy resources so as to extend the network period of time of WSNs. The planned algorithm designed to estimate the minimum transmission power for current link for data transmissions. In ATREM, the transmission range is computed at every interval for every sensing node and thus the transmission range of each sensing node is completely different because it is computed based on the 30 nodes network topology. We have a tendency to exploited the network connection parameter for dynamically adjust the transmission range of sensing nodes. The simulation results shows that proposed solution minimizing the energy consumptions and improvement of the network QoS (Quality of Service) performances.***

Keywords: ***Adaptive power control, Energy consumption, Network lifetime, QoS, Transmission Range, Sensor nodes.***

I. INTRODUCTION

A wireless sensor network (WSN) contains of little and smart sensor nodes that behaves collaboratively to observe the target setting [1]. Every sensor node contains a Sensor, Processor, communication Radio and inbuilt battery. These nodes are having resource constrained in terms of process power and battery capability [2]. WSN measures the physical and environmental conditions like pollution levels, temperature, sound, etc. The figure 1 shows the instance of WSN. The main activity of the any sensing node is to consume minimum power by the system. Radio system typically needs great amount of power [3]. Therefore it's the benefits to send data using the network, we needed. These sensor networks also support event driven data gatheration.

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It needs protocol for data to be forwarded [4]. Sensors should be consumes optimum power its important [5]. WSNs have been deployed in a wide range of civil applications as sensors become more powerful, smaller and cheaper. The major drawback of a sensor is its resource scarcity or constraint. Transmission of packets at a full power capacity may guarantee successful data delivery. But it may cause a rapid decay in battery power level.

Developing generic power preservation schemes is therefore challenging. There are several studies dedicated to prolonging sensor lifetime. Controlling transmission range according to link quality is an efficient approach as it provides the optimum power required to maintain a healthy link at a specific link quality.

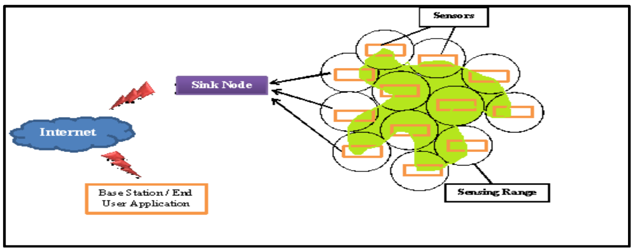

Figure 1: Wireless Sensor Network

Now-a-day's wireless transmitters and receivers for wireless nodes into the market that are more cost-effective, reduced in size, less power consumption and also smaller in antenna size [5]. Recent sensor-nodes having smart battery backup and these battery backups are reversible from system. For the WSN observance there are 3 sensor nodes these are the sensor nodes, wearable data acquisition and process hardware and remote monitor station are used. The sensors are responsible to monitor physical atmosphere and generates alert concerning prohibited activities to the customer [6]. Within the network several sensors are placed, These batteries are rechargeable automatically using solar system. These sensors small in size and cheap and those we will simply place within the network field. [7] It should cause entire network failure additionally. Therefore minimize the energy utilization /consumption of sensor nodes is wide studied analysis drawback. The nodes of wireless-sensor-networks have limited energy and it is difficult to replace battery of sensor node every time. So, the energy efficiency is a very important and very much important parameter in wireless sensor network.

In literature, the researchers are taking efforts to optimize wireless sensor networks

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life time using the assorted energy aware ways that use transmitter of sensor nodes in an efficient manner [6]-[14]. Energy control of Transmission aims to scale back the total transmission power of a wireless-network by adjusting the sending power at each sensor node. The energy efficiency may be achieved using the dynamic assignment of transmission range for every sensor node rather than kept fixed. In this paper, we planned the algorithm to perform the adaptive computation of transmission power level for every sensor node supported the current network topology known as ATREM. In section III, the proposed algorithm presented. In section IV, the simulation results are explained. And finally in section V, conclusion and future work is presented.

II. RELATED WORKS

There are number of strategies given for energy efficiency in WSNs supported completely different parameters. This section presents the related works based on transmission range parameter for the network life improvement.

In [6], author introduced the adaptive Transmission Power management (ATPC) methodology uses two phases: first is initialization and second is run-time standardization phase. Within the 1st phase, initially energy levels are tuned whereas these power levels are tuned in consistent with current scenario of the network within the next phase. However ATPC is intended only for the scenarios where collision of packets and congestion will happen so frequently.

In [7], real time Power Aware Routing (RPAR) was proposed. The main objective of this methodology was to route the data packets and so, the main focus is on reducing end-to-end delay. RPAR achieves this by runtime adjusting energy and routing selections based on packet delay deadlines. In addition, RPAR addresses necessary sensible issues in Wireless sensor networks, including scalability, lossy links, severe memory & information measure constraints. But author assume that every node will regulate its transmission energy and is aware of its location via Global Positioning System or different localization services.

In [8], author proposed dynamic transmission power control methodology to achieve the trade-off between the QoS performance and energy efficiency. The transmission power is dynamically adjusted based on network connectivity.

In [9], another method proposed that consider transmission energy improvement in WSNs when packets are gathered by receiver which is mobile in nature. This data-collector is dedicated for collecting data packets by selecting the optimize route that minimizes the overall transmit energy of the nodes subject to a max path delay constraint.

In [10], Michele Chincoli et.al investigated how artificial intelligence and machine learning is used to bring nodes to the lowest possible sending power level and, also, to respect the requirements of the overall network standardization. Lowering power has positive advantages in terms of both energy utilization and interference. The recent methodology proposed for transmission power control using a re-enforcement learning that set in a multi agent system. Similar level of works reported in [11]-[15].

In this paper we focused on designing the light weight algorithm together with AODV (Ad hoc On-Demand Distance Vector) in order to adaptively compute the transmission range of each sensor node based on the network connectivity in order to attain the trade-off between QoS and energy efficiency performances for WSNs. [16]-[21]

III. PROPOSED METHODOLOGY

As mentioned earlier sections, dynamical the transmission power manually could leads to various effects on QoS and energy performances of WSNs like increasing the transmission power results to interference in network and decreasing could result to longer delay. In this paper, we focused on adaptively choose the transmission vary to regulate the transmission power of every device nodes in network supported this network topology. The proposed ATREM protocol is include 2 sections like adaptive power control and transmission phase. The adaptive control of transmission power helps to enhance the network lifespan significantly as compared to state-of-art methods. In adaptive power control section, since after the network deployment we exploit the connection operate to compute the transmission range for every sensor node in network. The adjustment of power level in 1st section, second section is responsible to find the shortest energy efficient path to perform data aggregation and transmission from sensor nodes to sink node.

In Transmission range control methodology, the extra saved or harvested-energy is utilized to extend the sending range and incur in reduction within the number of packet travel hops. As a result, network will minimize the overall energy utilized by trace passing nodes. This methodology is specially useful in preventing traffic aggregation on the nodes near the sink node. Generally, the nodes close to the sink node need to transmit a larger amount of data packets than other nodes, so increasing the probability of dying earlier. As a state of dying leads to the consecutive blackout of neighboring nodes, also as a fast decrease within the knowledge rate, load balancing on nodes must be prevented. By increasing the sending range, in this methodology, data tends to be directly sent to the sink node instead of trace pass through intermediate hopping nodes. However, The algorithm one presents the working of proposed methodology.

Algorithm: Adaptive Power Control

Input:
S: sensor node
Sink: Sink node

step 1. At each interval **DO**
step 2. *S* computes all its current neighbor nodes in *nb*
step 3. *S* broadcasts beacon messages *nb*
step 4. Each neighbor *t* upon receiving beacon message sends

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- ACK packet t^{ack}
- Number of its neighbor t^{nb}

step 5. *S* computes the mean of its transmission power level using all neighbor outcomes t^{ack} and t^{nb} using Eq. [1]

step 6. $\mathbf{M^S = \sum_{k=1}^{n} t_i^{nb} / n}$ ….[1]

step 7. Select the transmission range i.e. transmission power according to value of M^S

step 8. Node S operates accordingly newly assigned transmission power until next interval of TDMA.

step 9. **While** (STOP)

step 10. Assigning the weight to each node starting from *Sink* node increasing order (0 for sink)

As shown in above algorithmic approach, every sensor node compute its own transmission power in kept with the present network connectivity at each interval in which mean of nodes connectivity computed and in kept with the transmission power allocated to current sensor node. Further, the weight is allotted to each sensor node in kept with its distance from the sink node in increasing order. In 2nd Section, The transmission range initiated by source a node that forwards the collected on-field data through the neighbours with least cost to enhance the QoS performance.

IV. PERFORMANCE ANALYSIS

We designed Wireless Sensor Network (WSN) with thirty nodes randomly distributed in area of 1000 * 1000 meter. One of them is sink (collector) node, and last five nodes are tied up with UDP agent, which generates traffic. Other rest of nodes is only forwarding nodes. Keeping packet size is 50 Bytes and reporting rate 10 packet/sec. assuming that the WSN is static. It uses routing Ad-hoc On Demand Vector(AODV) protocol and 802.11(MAC) as layer two protocols. The performance analysis of proposed methodology is performed against the existing fixed transmission ranges method using the NS2. We vary the transmission range from 100 to 350 meter in order to see the proposed methodology performance in which 5 sensor nodes sends the data to 1 sink node. We measured performance in terms of 4 metrics like average throughput, packet delivery rate, and delay and energy consumption.

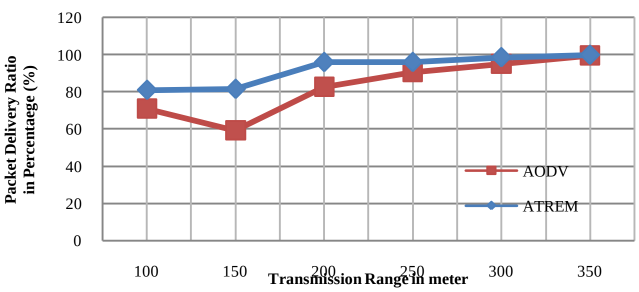

Figure 2: Packet Delivery Ratio as perform of Transmission Range

Packet Delivery Ratio (PDR) performance against transmission range is shown in figure 2. As the sending range at the sensor node will increase interference within the network.

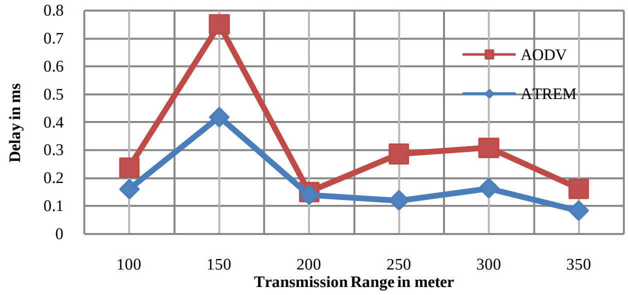

Figure 3: E-E Delay as perform of Transmission Range

As shown in figure 3, Delay as perform of sending range by node, the delay increases exponentially due to increase in interference results into congestion. Hence congestion increases number of retransmission. Due to congestion and retransmission the delay in the network increases.

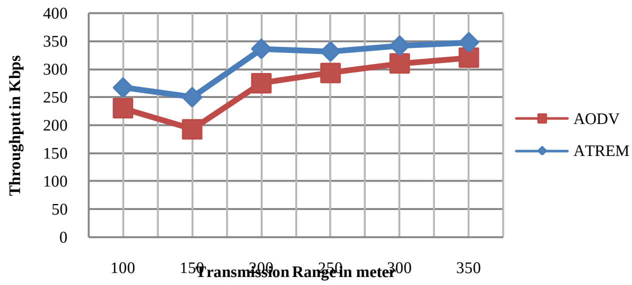

Figure 4: Node Throughput as perform of Transmission Range

Figure 4 shows Throughput as perform of sending range. These three figures are representing QoS performance evaluation. In both cases, the transmission range initially set to 100 to 350 meter. In existing case, the values are fixed throughout the complete simulation.

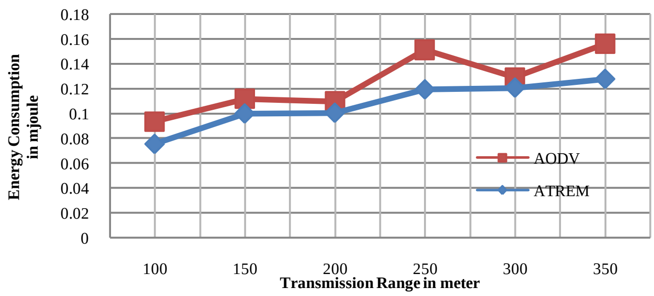

Figure 5: Average Energy Consumption as perform of Transmission Range

Average Energy Consumption as a perform of sending range is depicted in figure 5. This figure shows the energy efficiency performance analysis with transmission range. The energy consumption is constant for various transmission ranges. As the node density of the network is dense, therefore the average energy consumption is also less. Due to adaptive transmission power control, the proposed methodology achieved the stable and improved results in all

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cases as compared to existing fixed transmission range approach.

Similarly, we have designed the networks with varying transmission power from 20 dBm to 70 dBm for both fixed and dynamic scenarios. Figure 6, 7, and 8 represents QoS performance evaluation with respect to transmission power and figure 9 represent the energy efficiency performance analysis with respect to transmission power. The outcomes are discussed graphs. The Adaptive Power Control Algorithm proposed to increase the QoS parameter and consume less energy in the WSN. Whereas in proposed case, the transmission power is dynamically allotted to each sensor nodes this not only helps to enhance the energy efficiency but also improves the QoS performance.

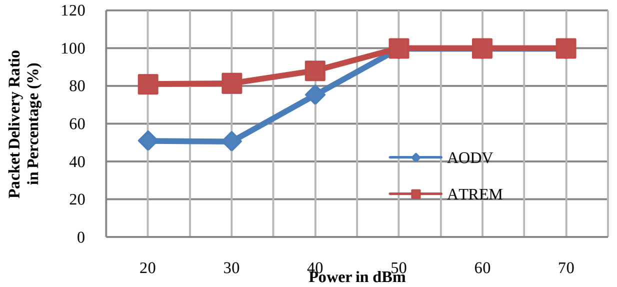

Figure 6: PDR Analysis vs Transmission Power

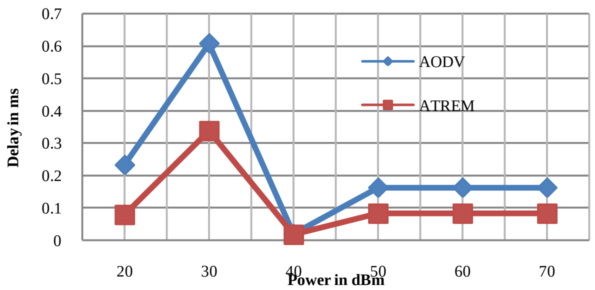

Figure 7: Average Delay Analysis vs Transmission Power

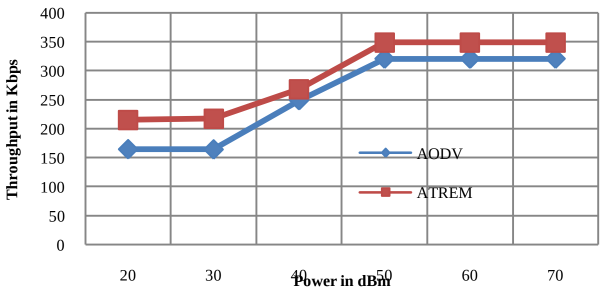

Figure 8: Average Throughput Analysis vs Transmission Power

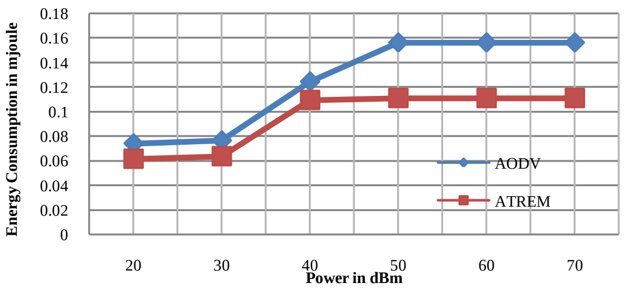

Figure 9: Average Energy utilization verses Transmission Power

Figure 9 shows Average Energy Consumption with respect to Transmission Power. The total of energy utilized for data transmission in normal power-control schemes are compared to see the result of sending power-control on energy consumption.

The result shows that after 50 dBm transmission power, the results are constant for both existing and proposed methods. The results satisfy the objective of proposed ATREM technique for WSNs.

V. Conclusion & Future Scope

This paper, first outlined the problems of fixed transmission power for WSNs, and then discussed the recent solutions to mitigate the dynamic transmission-power-control. We proposed the adaptive transmission range power control for WSNs in order to improve the QoS and energy efficiency performance. The transmission power is extremely crucial part of wireless sensor network. It affects all the quality of service parameter. At first it favors the sensor network and once certain threshold it affects the sensor network negatively. Therefore it's important to set appropriate transmission power. PDR as a perform of sending range and control overheads as a perform of sending range we'll conclude that the performance of the sensor network at the initial part is good. However as transmission range will increase once 100m performance of the network goes down with respect to packet delivery ratio, delay, jitter, and throughput. The algorithm is based on computation of neighbor nodes connectivity. The mean value is computed to perform the adaptive power control for each sensor node in network. The simulation result reveals the efficiency of proposed algorithm. So, controlling sending range & transmission power is a crucial parameter in sensor network.

For future work, we suggest working on various network scenarios and conditions. We'll extend the lifespan analysis into energy harvest WSNs. Since sensor nodes are provided by random renewable energy, it's very difficult to analyze and optimize the network lifespan under the continuous and unstable energy offer. The QoS factors will allow us to analyze the healthiness of networks, optimize their tunings, and to design more energy efficient applications.

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