To Enhance the Energy Efficient Active RFID protocol for Clock Synchronization using MAC-based Technique

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***Abstract*-Wireless sensor network is a self- organized network which is made up of various sensor nodes. Each sensor node is fully dependent on the battery. So energy consumption is the major concern in WSNs. Radio frequency identification (RFID) is the protocol for wireless sensor network which reduces the energy consumption. The main problem exists in RFID protocol is of clock synchronization. A lot of energy is consumed in synchronizing the WSN. In this paper, further enhancement is being proposed in RFID protocol for clock synchronization. In the proposed improvement the clocks of the sensor nodes is been synchronized on the basis of MAC time. When the time of the cluster head gets mismatched then the cluster head will adjust its clock according to the sensor node time which it received from the sensor nodes. The proposed technique has been implemented in simulated environmental conditions. The graphical result shows that proposed technique performs better than RFID protocol in terms of throughput, energy consumption, packet loss and delay in the network.**

***Key-words*- Wireless sensor networks, RFID, Clock synchronization, MAC-time.**

I. INTRODUCTION

Wireless sensor network consists of a large number of sensor nodes. Sensor nodes are used to sensing the area and collect information from the network [1].WSN controls hundreds or thousands of sensor nodes. All the sensor nodes are capable to communicate with each other and the base station (BS) directly or indirectly. WSNs generate the information by measuring physical parameters like temperature, pressure and humidity etc. Sensor nodes are fully dependent on batteries and are difficult to recharge or replacement the batteries. So energy consumption is the main problem in the wireless sensor network [2].The wireless sensor network consume lot of energy while transfer data from one device to other. There is need to adjust transfer and sensing rate to avoid energy consumption in wireless networks. To collect information is an energy efficient manner is difficult in wireless sensor networks. Many energy efficient techniques are available to reduce energy consumption such as LEACH, HEED, SEP, etc. Clustering is one of them. LEACH is an energy efficient technique that is widely used for minimize energy consumption but it has also some limitations. To overcome these limitation RFID protocol is used in wireless sensor network. The radio frequency identification (RFID) is an automatic technology which is based on radio frequency [3]. RFID is a technique that records and identifies data through radio waves. RFID is divided into two types according to the power source: active RFID and passive RFID [4]. Active tags use their own power resource to constantly power the tag & its RF (radio frequency) message circuitry. Passive radio frequency identification is powered by electromagnetic energy transmitted from a RFID reader. Passive tags have no internal power source like active RFID. Three, modes are applied on LEACH (Low Energy Adaptive Clustering Hierarchy) that are the Active mode, Ready mode and Sleep mode. This enhancement is called RFID protocol. In active mode, the node can only sense data. In ready mode, the node can sense the data as well as transmit the data to the base station. In sleep mode, the node can neither sense data nor transmit data to the base station. RFID enhances network performance and reduces energy utilization in WSNs better than LEACH but the main problem exists in RFID-based wireless sensor network is clock synchronization. A lot of energy is consumed in synchronizing the wireless sensor network. Time synchronization plays an important role in energy efficiency & node management. In clock synchronization process all the nodes and cluster head synchronized at the same time slot with in a network [5].

The remains of this paper are structured as follows. In section II, we describe the related work. In section III, we describe the proposed methodology. In section IV, we describe our simulation setup. In section V, we describe the results in terms of throughput, energy consumption, packet loss and delay. In section VI, we describe the conclusion of our work and future scope.

II. RELATED WORK

Golsorkhtabar *et al.* [6] developed a new protocol PEAP (new power Aware Energy Adaptive protocol with hierarchical clustering) to increasing the network life time and reducing the energy consumption for WSN. PEAP is based on clustering algorithm. In which, they made some assumptions about sensor nodes and the underlying network. First PEAP allocated the load among the more strong nodes as cluster-

head based on the special threshold value and then members of each set distance between the node &cluster head & also the cluster head &base station. So PEAP has a better performance for cluster head election than other cluster algorithms. The simulation result shows that the PEAP improve the network life time and energy consumption compared with another clustering algorithm .

Heikalabad *et al.* [7] proposed new EHDHR (energy balancing & dynamic hierarchical routing algorithm) for WSN to balancing the energy consumption among the nodes and protecting from energy holing problem. In this, the cluster formation and the election of cluster head are like LEACH but the data transmission from the cluster head to the base station is different. EHDHR assumed the distance between the base station and the cluster head in multi-hop in most time so this minimizing the unbalancing energy consumption of cluster heads near the base station. The simulation result shows that this protocol extends network life time 40% compared with LEACH.

Kumar et al. [8] In this paper they discussed in the wireless sensor networks to maximize the lifetime of the sensor network, for the data transfer the path is selected in such a way in which the energy consumption in minimized in that path. To support high scalability and better data aggregation, sensor nodes are often grouped into clusters. Clusters create hierarchical wireless sensor network, the sensor nodes utilization their limited resources in efficient way and thus extends network lifetime. They presented taxonomy of energy efficient clustering algorithms in WSNs, and also presented timeline and description of LEACH and its descendant in WSNs.

Ma & Yu [9] studies LEACH protocol & presents the improvement in LEACH protocol. They make the LEACH multi -hop. Multi-hop LEACH improves communication between the sink & cluster head. The simulation result shows that the enhanced LEACH is more energy efficient than LEACH protocol.

Golsorkhtabaramiri & Hosseinzadeh [10] introduced an SHCP (novel stable cluster-based protocol) for heterogeneous RFID enhanced wireless sensor network to improve the stability time and energy utilization. In SHCP, the cluster formation based on a number of current members that belong to a cluster head, nodes current energy, the distance between nodes and cluster heads and the chances of CHs election are based on the primary energy of node comparative to the other nodes in the network. The simulation results show that the SHCP has better stability period & energy consumption as comparative with SEP & LEACH.

Lee *et al.* [11] proposed RANO (reservation Aloha for no overhearing) that is used to inform the tag of its effective communication for eliminating over hearing problem. The energy consumption by the overhearing is many times larger than energy consumed for effective communication. To reduce this problem author proposes (RANO). A tag has information about the duration & time in advance so it maintain active mode during the sleeping mode of others in the transmission period. The result shows that this protocol saves the 60 times energy than another protocol .

Kaur & kumari [12] enhances the energy efficient Active RFID protocol for clock synchronization using NTP (network time protocol) in wireless sensor network & thereby enhancing the performance of wireless sensor network.

Nagpukar & jaiswal [13] discussed the wireless sensor network & RFID network integration. The integration of these two key technologies utilizes advantages of both systems thus making it more efficient & reliable and also discusses their respective advantages and disadvantages.

Sharma *et al.* [14] presents the modification in RFID protocol for clock synchronization. To overcome clock synchronization problem (RTS/CTS) packet are used. The simulation result shows that purposed technique has better performance than LEACH, RFID protocol in terms of throughput, energy consumption packet loss, delay in the network .

Singh *et al.* [15] proposed a novel technique to reduce effective collision by clock synchronization in RFID based wireless sensor network. This technique is based on the Diffusion based method in which any two nodes of the network set their clock accordingly when communicating with each other. The simulation results show that the energy consumption is decreased from 24 joules to 12 joules, packet loss is decreased from 50 to 10 packets and throughput is expanded from 11 to 72 packets.

III. PROPOSED METHDOLOGY

The proposed technique is based in the MAC time for the clock synchronization in the network. The node which aggregated the data to cluster head will also the sent the current time header. The cluster head when receives the packet will check the time header and when the time at the sensor node and cluster head gets mismatched, then the cluster head will adjust the clock according to the current time. In the last step, of clock synchronization the cluster heads will adjust its clocks according to the received time from their adjacent cluster heads. When the clocks of the sensor nodes get synchronized then the modes which are applied on each node will works efficiently and energy consumption in the network get reduced, also throughput increased at steady rate. The various steps of proposed method are as follows:

Step1: The network is deployed with the finite number of nodes.
Step2: In this step the location based clustering is followed and clusters are formed in the network and cluster head are chosen on the basis of ID.
Step3: Apply RFID protocol by embedding communication modes like Active, sleep and ready mode.
Step4: Embedding AODV routing protocol for data communication between one node to another node.
Step5: In this phase, clock time has checked between various nodes and their cluster head if the clock time is same than communication starts from the source to destination & if the clock time is mismatched then clock synchronization technique is applied for synchronizing the nodes.

(a) Aggregation of data-Sensor nodes in the cluster will aggregate its data to cluster head along with MAC time.

(b) Match clock time-Cluster head match their clock time with sensor nodes MAC time.

(c) If the MAC time of the sensor node gets mismatched with the time of cluster head then the cluster head will adjust its clocks according to the sensor node time. Similarly another cluster head in the network adjust their clocks with its corresponding sensor nodes.

(d) Calculate Average time-All the cluster head nodes in the network will calculate their own average time to synchronize their clocks in the network.

(e) Calculate final average time- All the cluster head nodes in the network will calculate their own average time to synchronize their clocks in the network.

(f) Each of the nodes or cluster head of the node set their time slot according final average time to synchronize their clocks in the network and start communication.

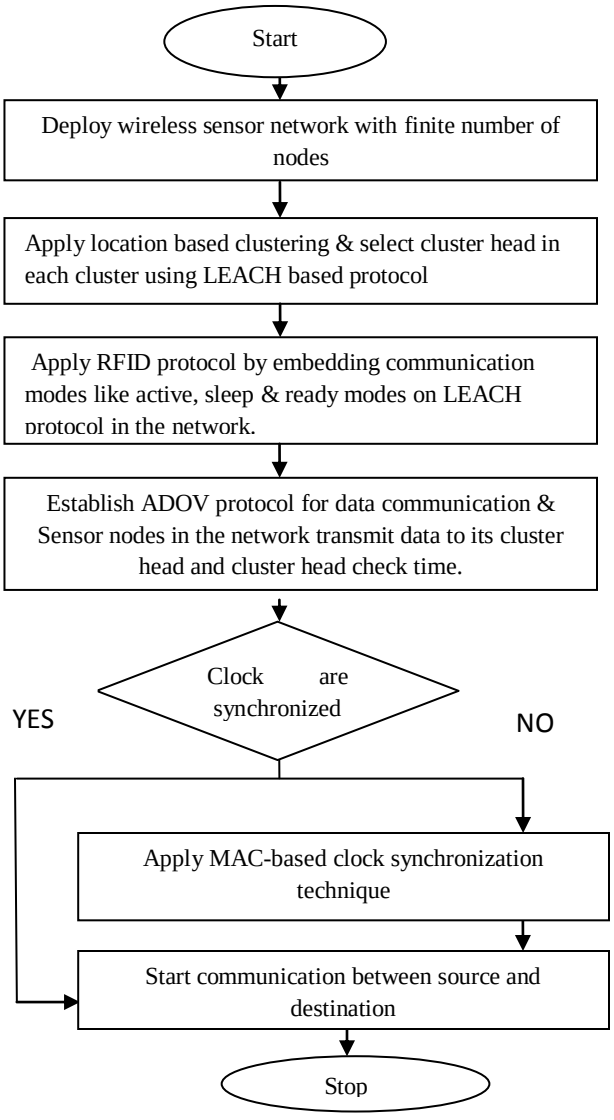

Figure 1: Proposed Flowchart

IV. SIMULATION SETUP

The whole scenario is implemented on Network Simulator version 2.35.The figure 2 shows the network setup of proposed work. The network setup consist 41 no. of nodes and 800*800 simulation areas in which the network is deployed. As shown in table 1, the following parameters have been taken as input while working on simulator to create virtual environment.

Table 1: NS-2 simulation parameter

Parameter	Settings
Simulation area	800*800 meters
No. of nodes	41
Channel type	Wireless channel
Antenna model	Antenna/ omni directional
Link layer type	LL
Simulation time	10s
Routing protocol	AODV
Standard used	802.11
Topology	Fixed

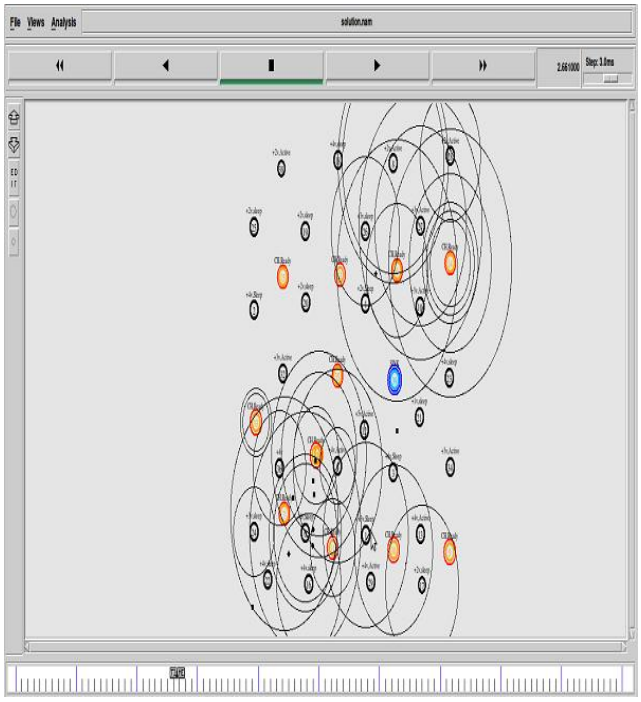

Figure 2: Network setup of proposed method

V. RESULTS

The WSN setup and clock synchronization process with chooses simulation parameters have been executed. The result got from the proposed procedure has been contrasted with the past work packet loss, energy consumption, throughput and delay. These are shown using X graph.

A. Energy Consumption:

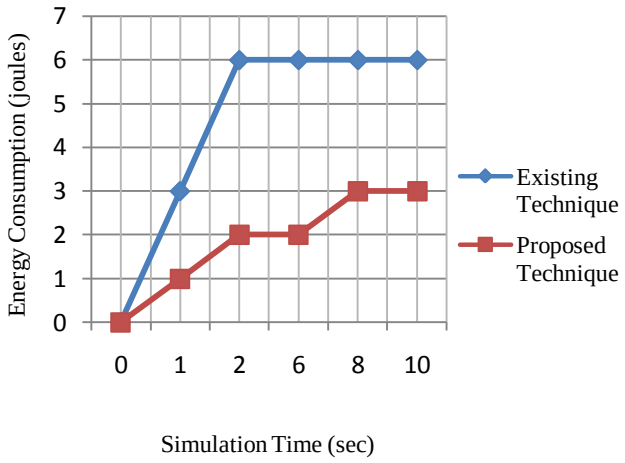

Figure 3: Energy consumption of existing technique v/s proposed technique

In the Figure 3, energy consumption of previous and new technique is shown. The red lines show the energy of proposed technique. The blue line shows the energy consumption in the existing technique. The clocks in the previous technique are not synchronized and fixed path are from source to destination. Due to these two reasons retransmission of the packet are required when packet loss is there in the network. In the new technique clocks are synchronized. The time is represented by X-axis and energy consumption in joules is represented by Y-axis This graphs show that proposed technique is efficient than the existing technique.

B. Packet loss:

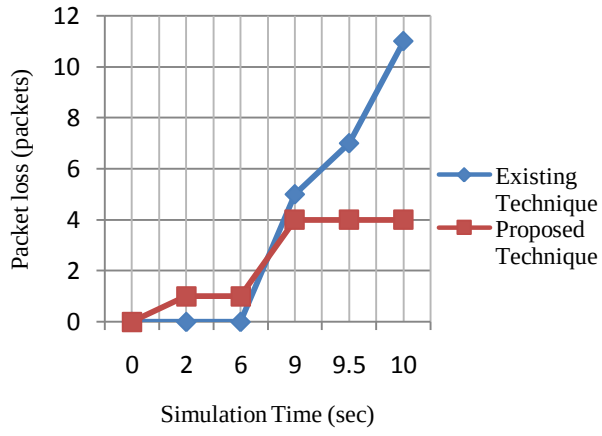

Figure 4: packet loss of existing technique v/s proposed technique

In the Figure 4, the packet loss graph is shown. The red lines show the packet loss of proposed technique. The blue line shows the packet loss in the existing technique. The packet loss is more in the previous technique. In the previous technique clocks of the cluster heads are not timely synchronized. This is the reason that the packet loss is higher is more in the previous technique. The packet loss in the new technique is reduced. The time is represented by X-axis and packet loss is represented by Y-axis. This graphs show that proposed technique is efficient than the existing technique.

C. End to End Delay:

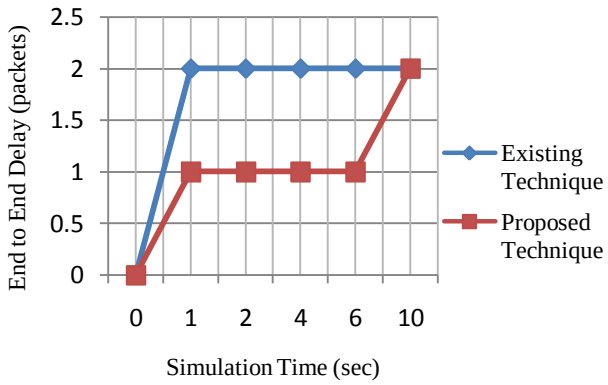

Figure 5: Delay of existing technique v/s proposed technique

In the Figure 5, calculates end to end delay the time taken for a packet to be transmitted across a network from source to destination graphs are shown. The red lines show the delay of proposed technique. The blue line shows the delay in the existing technique. The delay loss is more in the previous technique.

D. Throughput:

The Figure 6, illustrated the throughput of the new and previous technique. The red line shows the throughput of the proposed technique. The throughput of the existing technique is shown in blue line. The efficiency of the network is enhanced with the clock synchronization. The throughput the network is enhanced through the use of new proposed technique because the packet loss in the network is reduced.

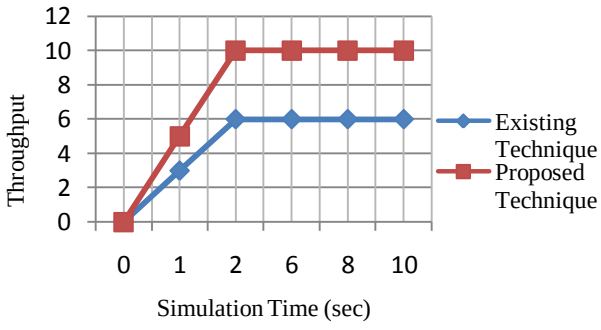

Figure 6: Throughput of existing technique v/s proposed technique

E. Matrices for performance analysis

Table 2 shows the performance analysis of existing method and proposed method. In this table we compare the existing method with proposed method in terms of energy consumption, packet loss, delay and throughput. Graph 5, shows the representation of existing as well as proposed system. The proposed technique performance is better than existing technique in terms of energy consumption, throughput, packet loss and delay.

Table 2: Performance Analysis

Parameter	Time (sec)	Existing technique	Purposed technique
Packet loss	10 sec	11 packets	4 packets
Energy consumption	10 sec	6 joules	3 joules
Delay	6 sec	2 packets	1 packet
Throughput	10 sec	6 packets	10 packets

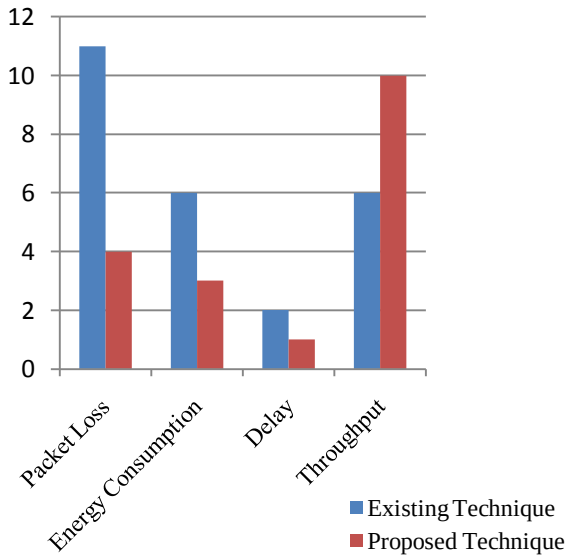

Figure 7: The comparison of proposed method with existing one

VI. CONCLUSION AND FUTURE SCOPE

We have studied existing energy efficient routing protocols and various challenges in wireless sensor networks. Wireless sensor network is generally deployed on the far places like forests & desserts etc. in such places recharge of replacement of batteries are very difficult. So energy consumption is the main problem exists in wireless sensor network. Many clustering based protocol has been used for reducing energy consumption. LEACH protocol is the one of them. Three mode are applied on LEACH for reducing energy consumption active, passive and sleep mode this enhancement is called RFID protocol. The main problem exists in RFID (radio frequency identification) is of clock synchronization which also create the problem of energy consumption and packet loss. In this work, clock synchronization problem has been reduced by using proposed technique. The simulation results show energy utilization is decreased from 6 joules to 3 joules, packet loss is reduced 11 packets to 4 packets and throughput is increased from 6 to 10 packets. In future, we will enhance proposed technique to reduce packet overhead in a network to reduce energy utilization.

REFERENCES

[1] J. Singh, "Simulation based analysis of RFID Protocol," In *Wireless Communications, Signal Processing and Networking (WiSPNET), IEEE*, pp. 1894-1897, 2016.

[2] A.A. Aziz, Y.A. Sekercioglu, P. Fitzpatrick and M. Ivanovich, "A Survey on Distributed Topology Control Techniques for Extending the Lifetime of Battery Powered Wireless Sensor Network," *IEEE Communications surveys & tutorials*, Vol.15, no.1, 2013.

[3] H. Kaur, M. Srivastava and S. Dutt, " A review of clock synchronization techniques in wireless sensor networks," *International journal of computer science and mobile computing",* vol.4, no.7, pp.247-252, 2015.

[4] M. Sharma, A. Singh and A. Chopra, "An Energy Efficient Techniques for RFID Protocol in Wireless Sensor Network: Review", *International journal of Computer Science and Information technology and security (IJCSITS)*, vol. 6, no.2, 2016.

[5] N. Kaur and R. Kumar, "Hybrid Topology Control based on Clock Synchronization in Wireless Sensor Network," *Indian journal of Science and Technology*, vol.9, No.31, 2016.

[6] M. Golsorkhtabar, M. Hosinzadeh , M.J. Heydari and S. Rasouli, "New power aware energy adaptive protocol with hierarchical clustering for WSN," *International Journal of Computer and Network Security*, vol.2, pp.38-40. 2010.

[7] S.R. Heikalabad, A.H. Navin, M. Mirnia, S. Ebadi and M. Golesorkhtabar, "EBDHR: Energy Balancing and Dynamic Hierarchical Routing algorithm for wireless sensor networks," *IEICE Electronics Express*, vol.7, pp.1112-1118, 2010.

[8] V. Kumar, S. Jain and S. Tiwari, " Energy efficient clustering algorithms in wireless sensor networks: A Survey," *International journal of computer Science Issues*, vol.8, No.5, 2011.

[9] X.W. Ma and X. Yu, "Improvement on LEACH protocol of wireless sensor network," *Trans Tech Publications in Applied Mechanics and Materials*, vol.347, pp.1738-1742, 2013.

[10] M. Golsorkhtabaramiri and M. Hosseinzadeh, "A novel stable cluster-base protocol for heterogeneous RFID enhanced wireless sensor networks," *QScience Connect*, vol.35, 2013.

[11] C.S. Lee, D.H Kim and J.D. Kim, "An energy efficient active RFID protocol to avoid overhearing problem," *IEEE Sensors Journal*, vol.14, pp.15-24, 2014.

[12] K. Kaur and N. Kumari, "Evaluation and analysis of active RFID protocol in wireless sensor networks," *International Journal of*

Innovative Technology and Exploring Engineering (IJITEE), vol.4, pp.11-19. 2014.

[13] A.W. Nagpukar and S.K. Jaiswal, "An overview of WSN and RFID network inte-gration," In *Electronics and Communication Systems (ICECS) IEEE*, pp. 497-502, 2015.

[14] T. Sharma, H. Singh and A. Sharma, "Energy Optimization of Hierarchical Wireless Sensor Networks using RFID Algorithm," *International Journal of Grid and Distributed Computing*, vol.8, pp.239-246, 2015.

[15] A. Singh, A. Chopra and G. Kaur, "To proposed a novel technique to remove efficient collision by clock synchronization in wireless sensor network," *International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC)*, vol.4, Issue 7, PP.2321-8169, 2016.