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ENERGY EFFICIENT MODELFOR DATA AGGREGATION AND OFFLOADING FOR DISTRIBUTED NETWORK

Manishankar S. and S. Sathayanarayana
Department of Computer Science, School of Computer Science and Engineering, Bharathiar University, Coimbatore, India
E-Mail: manishankar1988@gmail.com

ABSTRACT

Real time data collection from distributed network and nodes are one of the most common part of any application in this era of Information Technology. Aggregation of Data from heterogenous mobile and sensor devices is a challenging task. The task of data aggregation and migrating to a centralized platform and offloading data require a energy efficient platform. The research proposes model of deployment for sensor network data collection and storage. The major objective is data aggregation and offloading with the help of improvised LEDA (Low energy Adaptive Algorithm) which clusters the network considering QOS parameters, creates an offloading criterion for data to be transferred in case of low bandwidth availability. A Performance monitor is incorporated in the network to track QoS parameter to support the decision making essential for aggregation and offloading. The system improves energy and life time of the network considerably.

Keywords: real-time sensors, cluster network, data aggregation, QOS, QOE, data offloading, energy optimization.

1. INTRODUCTION

Any information system basis is collection of data and storing it to a data center which has high availability. Considering a system like that of geographical sense data, the area of the coverage of the nodes transmitting data is huge and data can be from various heterogonous sources distributed over large area. Most of case popular source of data are from sensing devices. Data collection in such a case becomes highly difficult when sensors are various types and geographical distribution is varied one [1]. Maintaining the communication for a longer duration is highly difficult as all sensors are associated with power and back up. So, there should be a efficient energy management in the network. Efficient communication to collect data from sensors always supplements to energy efficiency. Communication technology should be a one with minimum overheads so that it becomes easy for collection of data. One of the approach in the existence scenarios is that making a cluster for distributed sensors so that control of sensor can be carried out as well as data connection can be happening with the help of cluster head [2], Then arises a question how cluster head selection happens, for that there are algorithm similar to Cluster head selection Algorithm where we can observe when implemented with a LEACH [3] [4] algorithm the improvement of efficiency was achieved. Another approach that can be Implemented to make a network efficient is the presence of a sink node [5] in cluster improves the efficiency as data collection need not happen in a full time manner which always reduces the energy and also much more time consuming task. Expectation maximum is one of the thing in sensor where we can improve the efficiency easily by adding the remain mean time energy for each node and then with the help of that calculating the average expected energy of the cluster which helps in reforming the cluster even in presence of disturbance happening in the system. [2]

Working of the cluster formation happens in this way At the first stage of cluster formation, a node randomly selects a number between 0 to 1, compares this number to the threshold values labeled as t(n). If the number is less than t(n), then it became cluster head in that particular round, else it become common node in the network. Threshold t(n) is determined by the following mathematical formula:

$$t(n)=\begin{cases}\dfrac{p}{1-p*(r \bmod \frac{1}{p})} & \text{if } n\in G\\ 0 & \text{if } n\notin G\end{cases}$$

Where p is the percentage of the cluster head nodes among all nodes in network, r is the present round number; G is the collections of the nodes that have not yet been assigned as head nodes in the first 1/P rounds. Using this threshold, all nodes will be able to be head nodes after 1/P rounds. Once the clusters are made and the schedule is settled, information transmission can start. The non-clustered head hubs send information to bunch head hub amid their allotted transmission time. When every one of the information has been received, the cluster head node performs signal preparing to compress the information into a solitary signal. At that point, this signal is sent to the BS. The measure of data is reduced because of the data collection done at the cluster head node [6]. This round is done, and the following round starts with set-up and consistent state stages over and over. To keep away from pointless nodes control messages transmission and control overhead of the BS, bunches are re-made just when the sensor hub can't work in a sure round. Along these lines, the ascertaining overhead is just cluster head selecting in the most set-up.

As the cost reduction is a popular agenda that is being followed by companies and organization of public and private sector usage of virtual data centers are much more preferred than setting up an individual data center for each company.

Cloud migration of data is one of the essential features for information spread a larger area. [7] Cloud gives flexibility in storing data and as well providing a high availability platform for storage. Offloading data from sink node [8] makes it easier as cloud provides a distributed area and support as well as eliminates the requirement for a fixed infrastructure for storage through virtualized platform. IAAS cloud maintains quite easy as service provider has the role in

2. SURVEY OF EXISTING TECHNOLOGIES

There is a lot of research work carried out in wireless sensor network, cloud computing and about various data collection and management techniques in both the fields.

Some of the major works are listed below.

[9] Proposed work talks about a novel technique to collect Data from distributed Wireless Sensor network with the help of a Sink node they had used an scheme which provides, Expectation Maximization Algorithm (EM), and also selection Clustering of sensor Algorithm based on EM, Direct Diffusion scheme is used for data collection. Obtain an result about energy consumption for data transmission efficiency, Sum of energy consumption of data transmission and data request and also obtained optimal number of cluster.

[10], studies suggest a way to improve the energy efficiency in leach algorithm by proposing a novel method on cluster head selection. The addition of two, algorithm such as Cluster head selection Algorithm, Remaining energy calculation Algorithm helps for a better technique to handle efficient energy of the system. Presence of sink node if included helps to offload data and save energy in much better way.

[11]analyzes massive sensor data management in cloud manufacturing system and building a parallel storage and processing using Hadoop to overcome the drawbacks of traditional Database. It provides a frame work for storing unstructured as well as semi structured data and provided a platform for organizing massive data from sensor and realizes parallel processing efficiently. Specifying an efficient communication technology between the sensor nodes and Hadoop can be integrated for better results.

[12], proposed Parallel programming platform for enhancing map-reduce functionality for hadoop and Spark by using fault tolerance with TRIPLE-H, Map-reduce Tachyon work load allocation of iterative application. author has considered parameters like block size, cluster size ,number of concurrent task and primitive operation on HDFS and Spark .Fault tolerance can be enhanced if failure recovery techniques included to the system,

[13], mathematical formulation of sensor cloud and studying behavior WSN-applications on a sensor cloud. Results obtained shows that cloud sensor platform outperforms traditional WSN. Performance metrics such as energy consumption, Life time of a sensor, Fault tolerance, cost effectiveness are considered in analysis. Including a communication overhead parameter and network response time can give an improved result.

[14] Minimize the delay in data collection networks in a centralized and decentralized approach. Network formation is done with the help of calculation of energy consumed by wireless sensor node. Network formation algorithm provides the results together with a single tree structure and also various numerical calculations are carried forward. The performance of the proposed network is compared with multi two hop cluster and a collection of tree network structure. More issues related to communication protocol are not addressed which can become more effective for the data collection.

The work in existing system is also compared to that with IoT data collection; there is similarity in data acquisition that happens. Some of the related work as listed below. There are many experimentations conducted and algorithms designed in the area of data acquisition with IoT. Rabab J. Mohsin *et al* [15] has conducted and survey about the application of proper data quantization and compression techniques for the sensors which collect the data in order to bring down the pressure on the channels and achieve better transmission. Chunsheng Zhu *et al* [16] has developed a structure that will increase the lifetime of the WSN networks, reduce the amount of storage used by the sensors and the sink nodes of the wireless sensor networks, and decrease the load of the traffic and bandwidth needed for the transmission of the data. George Suciu *et al* [17] has developed a suitable framework for data acquired from the IoT sensors that can be managed automatically by distributed services which are cloud based. Rabab J. Mohsin *et al* [18] has surveyed the effects of different marine time MANET protocols such as AODV, AOMDV and DSDV. Bing Hui *et al* [19] has proposed a framework for the need of provided that high effective real-time facilities to ship ad-hoc network. Alessio Botta *et al* [20] has majorly focused on the cloud computing and IoT combination. Sherif Abdel Wahab *et al* [21] has proposed a design called CARS which facilitates group of Sensitivity data, world-wide Resource & allocation of data between the sensors. Abdur Rahim Biswas *et al* [22] has outlined an Internet of Things is centric to Cloud smart infrastructure for distinct IoT and opportunities in the cloud computing. Jiehan Zhou *et al* [23] concentrated on the combination of IoT & Cloud Computing which is named as Cloud things architecture. Fei Li *et al* [24] described the IoT architecture on which IoT resolutions that can be carried out as virtual devices by having the resources for computing and all the required middleware on the cloud.

From all the existing works carried out so far it is very clear that there are lack of efficiency in terms of identifying QoS parameters and the impact is directly proportional to life time of the sensor network and hence a legitimate estimation has to be focused in terms of identifying better QoS and QoE parameters by introducing a better model integrating data aggregation and offloading which is discussed below.

3. METHODOLOGY

A. Clustering the network using LEDA

To begin with data collection a network is divided into clusters with the help of LEACH algorithm. Which clusters the node with lower energy consumption and improved life time of the network. It is a hierarchical clustering algorithm and cluster heads are chosen dynamically. Cluster heads are responsible for aggregation,

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compression and forwarding of the data. The probability is calculated for each node to become cluster if there is P node probability lies as 1/P. At the end of each round node that is not a cluster head selects the closest cluster head and joins the cluster.

LEDA also does the clustering of network similar to LEACH but only difference is that it chooses the first level cluster head based on network perception which is depended on the number of nodes in the network and number of cluster. the initial cluster heads energy and total performance of the network based on energy, delay, bandwidth utilization etc. are measured and based on the value next set of cluster heads are selected.

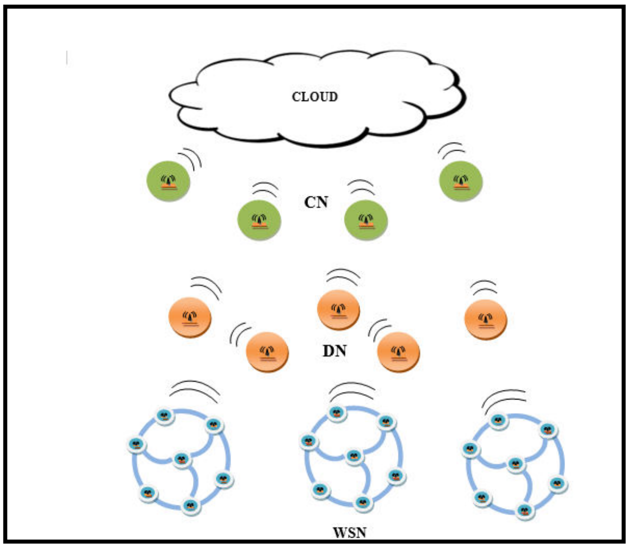

Figure-1. Architecture data aggregation LEDA.

The clustered network is then considered for an efficient data aggregation technique (LEDA).[15]. LEDA considers multiple sink node (Data node) and involves aspects like distance calculation between cluster members, cluster head. LEDA after clustering does the aggregation of data that is collecting the mean value of the data results obtained from the sensors. The aggregated values are available either in the sink node or in cluster head. The performance monitor attached to the cluster checks the efficiency in which data gets aggregated, the value from the performance monitor helps in decision on frequency and duration of aggregation. As the aggregation is efficiently monitored it leads to increased energy and life time of network. The next task is to offload the data when availability of the bandwidth is low or not sufficient.

B. QoS and QoE based data aggregation and offloading algorithm

The proposed network addresses an environment which comprises of large number of nodes spread across a huge area. The sensor nodes are then clustered together in to a network and each cluster gets associated to a sink node who is responsible for the transmission of data. The network mainly involves many Data terminal and connection equipment's which can perform a uniform data generation and collection. One end of the network is associated to the cloud server which is responsible for managing and storing data.

The architecture of the depicted in Figure-1 express the cluster architecture of the network and data aggregation happening in the cluster with the help of the data node which helps the cluster head in data collection. Clustering in the network is governed by LEDA algorithm (LOW energy Adaptive Cluster Algorithm). Data node is assisted with the help of LEDA algorithm. QOS and QOE (Quality of Experience) of the network is considered to optimize the network. The aggregate values are offloaded based on offloading criteria, offloading criteria is coined by considering the values of network bandwidth like available bandwidth, speed of the supporting medium, maximum allotted capacity and user request. Threshold of the bandwidth, distance and cluster size are set based on performance monitor. Each round parameter values are compared with threshold to make the decision to offload the data are not to the sink. LEDA plays a vital role

Model for the cluster formation and aggregation

Consider a network of 'n' node which has to be clustered in to 'C' clusters Initial we must evaluate the probability of node becoming cluster head

$$T(n) = \frac{p}{1 - p(r \bmod \frac{1}{p})} \quad \forall n \notin C \tag{1}$$

T(n)=0 $\quad \forall n \notin C$

Where p is the probability and r is the round number.

Number of steps (ns)in the transmission and number of rounds in transmission are evaluated by

$$nc = \gamma di^2 \tag{2}$$

$$ns = \frac{n}{rdi^2} \tag{3}$$

where nc is the cost of each transaction involved

Now to calculate number of transactions

$$nT(di) = c(\gamma(di-1)^2 + \gamma\sum_{j=1}^{di}(2j-1)j \tag{4}$$

$$nT(di) = cr((di-1)^2 + \frac{1}{3}di(di^2-1) \tag{5}$$

For each channel to set a threshold a calculate channel capacity which refers to bandwidth utilization and packet loss in each transmission round nT.

$$Cc = 2B\log N \tag{6}$$

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$$Cc = B\log(1+\frac{s}{n})$$

$$P_L = \frac{NP_L}{N\,\mathrm{P}_R}$$

Where P_L the packet Loss ration NP_L number of packet lost in the round and NP_R number of packet received threshold for the round

The model evaluates the QoS and QoE parameter using the above mathematical model and sets the condition for calculation of energy as the LEDA algorithm does

I. calculate the Overall energy of the cluster in a round Er

$$Energyremain = 4000(2*N*Tx$$
$$+N*Energyavail$$
$$+rounds*MP*dis^4 +$$
$$N*Energysaved*dis^2$$

II. $$Qos = \frac{P(nc)+ns(Cc*NP_l\,)}{nT(dt)*P_L}$$

III. $$QOE = \frac{\sum_{n=1}^{T} ns + Cc(NP_R * Energysaved)}{\sum P_L * Energyremain * dis}$$

LEDA with parameters of QoE and QoS improve the system a lot to decide on the offload criteria. Based on the QoE the type of application that requires energy lot will be decided not to communicate. if QoE and QoS factor less than threshold set then transmission is not initiated else communications start and migration of data happens Calculation of the QoE and QoS has benefited increasing the life time of network and energy as a total, the reason behind the efficiency is dynamic choice of the cluster head and sink node based on QoS parameter, offloading plays a vital role in balancing the bandwidth utilization with help of QoE parameter.

4. IMPLEMENTATION RESULTS

The network required for research is simulated with help of Omnet++ IDE, Omnet ++ supports a distributed WSN model with the help of Castalia, and values from stimulated sensor are taken in as observation. The network has the initial parameter as given below in the Table-1.

Table-1. Network parameters.

Parameters	Values
Connection type used	Adhoc
Distance to Rx	200 M
Energy	0.6 J
Number of Clusters	10
Number of Packets	10000
Packet Size	200 Bytes
Time Interval	1 sec

These parameters of the network help to study and categorize network easily. The network is an Adhoc one and distance between nodes are taken as 200m and energy of each node initial is taken as 0.6 J, and number of packet send is 200 bytes.

The network is then initialized, and broadcast communication takes place, the network contains many sensor nodes and data nodes are the intermediate node implemented in LEDA and sink is the controller for the data nodes. Cloud has the one endpoint to the distributed cloud computing environment

The initial broadcast communication starts, and sensor actuates and collects the data and sensing as well as communication is depicted using the ring of transmission in concentric circles. Figure-5 depicts the broadcast and Data nodes aggregate the data from sensors and track the parameters of QoS and QoD based on the values track makes

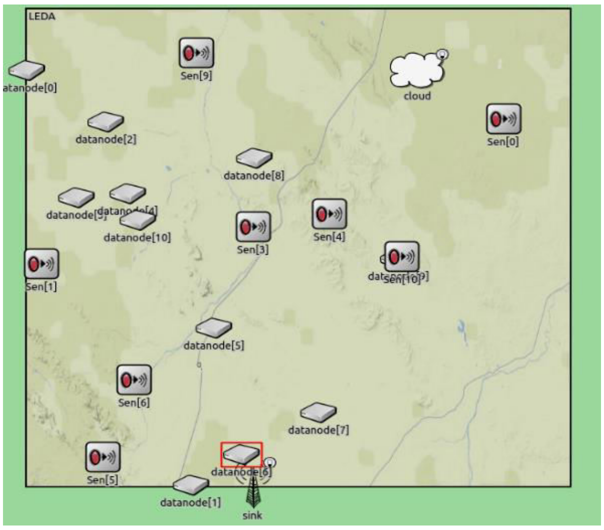

Figure-2. Network model in Omnet++.

The calculation of Network perception using NPP and NPC, Range communication, transmission energy, remaining energy, delay of cluster, bandwidth of cluster and number of packet send and received are monitored by the performance monitor.

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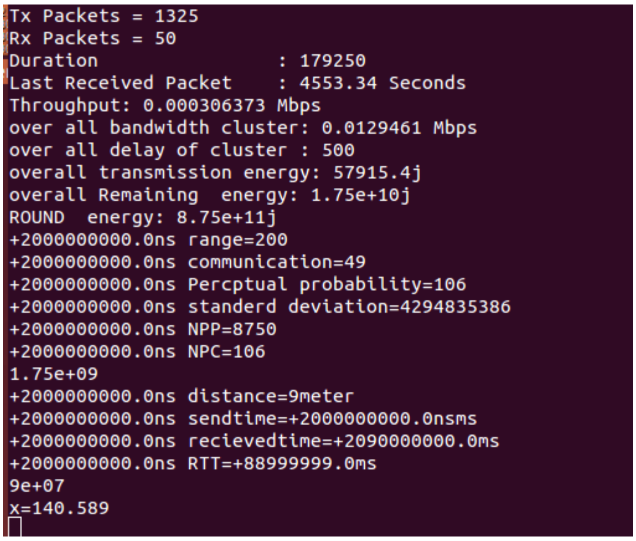


```
Tx Packets = 1325
Rx Packets = 50
Duration                   : 179250
Last Received Packet       : 4553.34 Seconds
Throughput: 0.000306373 Mbps
over all bandwidth cluster: 0.0129461 Mbps
over all delay of cluster : 500
overall transmission energy: 57915.4j
overall Remaining  energy: 1.75e+10j
ROUND  energy: 8.75e+11j
+2000000000.0ns range=200
+2000000000.0ns communication=49
+2000000000.0ns Percptual probability=106
+2000000000.0ns standerd deviation=4294835386
+2000000000.0ns NPP=8750
+2000000000.0ns NPC=106
1.75e+09
+2000000000.0ns distance=9meter
+2000000000.0ns sendtime=+2000000000.0nsms
+2000000000.0ns recievedtime=+2090000000.0ms
+2000000000.0ns RTT=+88999999.0ms
9e+07
x=140.589
```

Figure-3. Performance monitor results.

The results from the performance monitor in the Figure-4 is fed in to the LEDA algorithm and Offloading criteria to make decision.

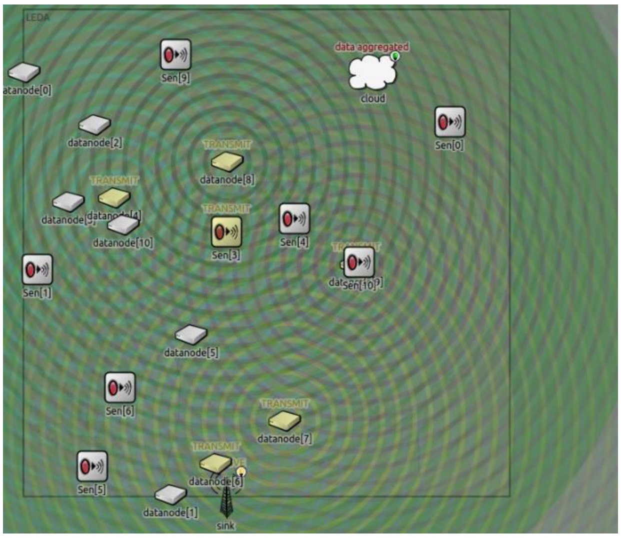
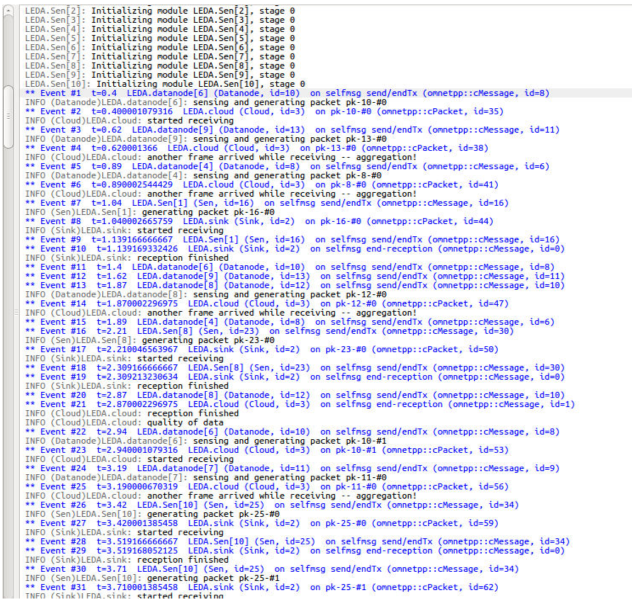


Figure-4. Initial broadcast and data transmission.

The communication continues, and LEDA take the basic clustering of the nodes and choice of cluster head node is done. The sink node and cluster head communicate and QoS and QoE parameters are taken in to observation. The decision is taken based on the Offload algorithm and mathematical model works as the basis for the calculation. The readings are noted from the simulator in to trace file where it is recorded each change with respect to bandwidth, delay or packet drop, the data recorded from the initialization of network to data aggregation looks as depicted in Figure-5 below, the readings are in the form of packet send, received, communicated, drop of packet, delay which are vital in deciding the overall parameter for the QoS and QoE factors.



```
LEDA.Sen[2]: Initializing module LEDA.Sen[2], stage 0
LEDA.Sen[3]: Initializing module LEDA.Sen[3], stage 0
LEDA.Sen[4]: Initializing module LEDA.Sen[4], stage 0
LEDA.Sen[5]: Initializing module LEDA.Sen[5], stage 0
LEDA.Sen[6]: Initializing module LEDA.Sen[6], stage 0
LEDA.Sen[7]: Initializing module LEDA.Sen[7], stage 0
LEDA.Sen[8]: Initializing module LEDA.Sen[8], stage 0
LEDA.Sen[9]: Initializing module LEDA.Sen[9], stage 0
LEDA.Sen[10]: Initializing module LEDA.Sen[10], stage 0
** Event #1  t=0.4  LEDA.datanode[6] (Datanode, id=10)  on selfmsg send/endTx (omnetpp::cMessage, id=8)
INFO (Datanode)LEDA.datanode[6]: sensing and generating packet pk-10-#0
** Event #2  t=0.400001079316  LEDA.cloud (Cloud, id=3)  on pk-10-#0 (omnetpp::cPacket, id=35)
INFO (Cloud)LEDA.cloud: started receiving
** Event #3  t=0.62  LEDA.datanode[9] (Datanode, id=13)  on selfmsg send/endTx (omnetpp::cMessage, id=11)
INFO (Datanode)LEDA.datanode[9]: sensing and generating packet pk-13-#0
** Event #4  t=0.620001366  LEDA.cloud (Cloud, id=3)  on pk-13-#0 (omnetpp::cPacket, id=38)
INFO (Cloud)LEDA.cloud: another frame arrived while receiving -- aggregation!
** Event #5  t=0.89  LEDA.datanode[4] (Datanode, id=8)  on selfmsg send/endTx (omnetpp::cMessage, id=6)
INFO (Datanode)LEDA.datanode[4]: sensing and generating packet pk-8-#0
** Event #6  t=0.890002544429  LEDA.cloud (Cloud, id=3)  on pk-8-#0 (omnetpp::cPacket, id=41)
INFO (Cloud)LEDA.cloud: another frame arrived while receiving -- aggregation!
** Event #7  t=1.04  LEDA.Sen[1] (Sen, id=16)  on selfmsg send/endTx (omnetpp::cMessage, id=16)
INFO (Sen)LEDA.Sen[1]: generating packet pk-16-#0
** Event #8  t=1.040002665759  LEDA.sink (Sink, id=2)  on pk-16-#0 (omnetpp::cPacket, id=44)
INFO (Sink)LEDA.sink: started receiving
** Event #9  t=1.139166666667  LEDA.Sen[1] (Sen, id=16)  on selfmsg send/endTx (omnetpp::cMessage, id=16)
** Event #10  t=1.139169332426  LEDA.sink (Sink, id=2)  on selfmsg end-reception (omnetpp::cMessage, id=0)
INFO (Sink)LEDA.sink: reception finished
** Event #11  t=1.4  LEDA.datanode[6] (Datanode, id=10)  on selfmsg send/endTx (omnetpp::cMessage, id=8)
** Event #12  t=1.62  LEDA.datanode[9] (Datanode, id=13)  on selfmsg send/endTx (omnetpp::cMessage, id=11)
** Event #13  t=1.87  LEDA.datanode[8] (Datanode, id=12)  on selfmsg send/endTx (omnetpp::cMessage, id=10)
INFO (Datanode)LEDA.datanode[8]: sensing and generating packet pk-12-#0
** Event #14  t=1.870002296975  LEDA.cloud (Cloud, id=3)  on pk-12-#0 (omnetpp::cPacket, id=47)
INFO (Cloud)LEDA.cloud: another frame arrived while receiving -- aggregation!
** Event #15  t=1.89  LEDA.datanode[4] (Datanode, id=8)  on selfmsg send/endTx (omnetpp::cMessage, id=6)
** Event #16  t=2.21  LEDA.Sen[8] (Sen, id=23)  on selfmsg send/endTx (omnetpp::cMessage, id=30)
INFO (Sen)LEDA.Sen[8]: generating packet pk-23-#0
** Event #17  t=2.210046563967  LEDA.sink (Sink, id=2)  on pk-23-#0 (omnetpp::cPacket, id=50)
INFO (Sink)LEDA.sink: started receiving
** Event #18  t=2.309166666667  LEDA.Sen[8] (Sen, id=23)  on selfmsg send/endTx (omnetpp::cMessage, id=30)
** Event #19  t=2.309213230634  LEDA.sink (Sink, id=2)  on selfmsg end-reception (omnetpp::cMessage, id=0)
INFO (Sink)LEDA.sink: reception finished
** Event #20  t=2.87  LEDA.datanode[8] (Datanode, id=12)  on selfmsg send/endTx (omnetpp::cMessage, id=10)
** Event #21  t=2.870002296975  LEDA.cloud (Cloud, id=3)  on selfmsg end-reception (omnetpp::cMessage, id=1)
INFO (Cloud)LEDA.cloud: reception finished
INFO (Cloud)LEDA.cloud: quality of data
** Event #22  t=2.94  LEDA.datanode[6] (Datanode, id=10)  on selfmsg send/endTx (omnetpp::cMessage, id=8)
INFO (Datanode)LEDA.datanode[6]: sensing and generating packet pk-10-#1
** Event #23  t=2.940001079316  LEDA.cloud (Cloud, id=3)  on pk-10-#1 (omnetpp::cPacket, id=53)
INFO (Cloud)LEDA.cloud: started receiving
** Event #24  t=3.19  LEDA.datanode[7] (Datanode, id=11)  on selfmsg send/endTx (omnetpp::cMessage, id=9)
INFO (Datanode)LEDA.datanode[7]: sensing and generating packet pk-11-#0
** Event #25  t=3.190000670319  LEDA.cloud (Cloud, id=3)  on pk-11-#0 (omnetpp::cPacket, id=56)
INFO (Cloud)LEDA.cloud: another frame arrived while receiving -- aggregation!
** Event #26  t=3.42  LEDA.Sen[10] (Sen, id=25)  on selfmsg send/endTx (omnetpp::cMessage, id=34)
INFO (Sen)LEDA.Sen[10]: generating packet pk-25-#0
** Event #27  t=3.420001385458  LEDA.sink (Sink, id=2)  on pk-25-#0 (omnetpp::cPacket, id=59)
INFO (Sink)LEDA.sink: started receiving
** Event #28  t=3.519166666667  LEDA.Sen[10] (Sen, id=25)  on selfmsg send/endTx (omnetpp::cMessage, id=34)
** Event #29  t=3.519168052125  LEDA.sink (Sink, id=2)  on selfmsg end-reception (omnetpp::cMessage, id=0)
INFO (Sink)LEDA.sink: reception finished
** Event #30  t=3.71  LEDA.Sen[10] (Sen, id=25)  on selfmsg send/endTx (omnetpp::cMessage, id=34)
INFO (Sen)LEDA.Sen[10]: generating packet pk-25-#1
** Event #31  t=3.710001385458  LEDA.sink (Sink, id=2)  on pk-25-#1 (omnetpp::cPacket, id=62)
INFO (Sink)LEDA.sink: started receiving
```

Figure-5. Reading tracked from the simulator.

The sensors nodes transmit the data and it is then aggregated into the data nodes which are in turn responsible for the checking the QoS and QoE parameter for communication and take the decision of the offload based on the offload algorithm, thus that node meeting condition starts offloading.

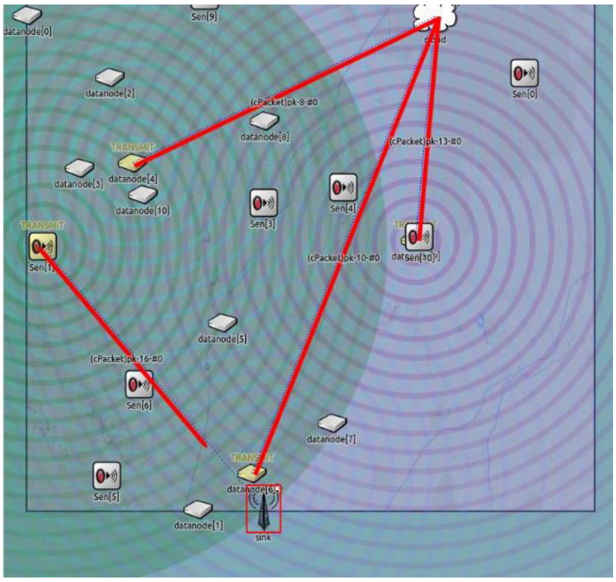


Figure-6. Levels of aggregation with Offload.

The simulation of the offloading and aggregation of data in to cloud is depicted in the simulator below. Sensor node communicates with the sink node named as data node also the figure depicts the offloading happening between data nodes. Here the Cloud shaped object is the sink which later transmits the data to the cloud.

The data are being offloaded in various leveled fashion depending on the offload criteria made, the Figure-6 depicts the aggregation of data transmitted from the nodes based on criteria from QoS and QoE factors obtained. The comparison of QoEand QoS parameter is done only by considering LEDA with the proposed system that has both LEDA and Offload criteria. Results of the comparison are depicted in the graph in Figure-7.

Observations prove that QoE has improved, packet drop has decreased considerably, Bandwidth has improved with slot time and energy increasing to greater extend. Thus, the results of simulation support the study that considering QoS and QoE parameters for Offload criteria helps in improving the overall life time of the network leading to a quality network.

Thus the LEDA already an improved algorithm to LEACH has been further improved with help of QoS and QoE parameter. The Graph shows

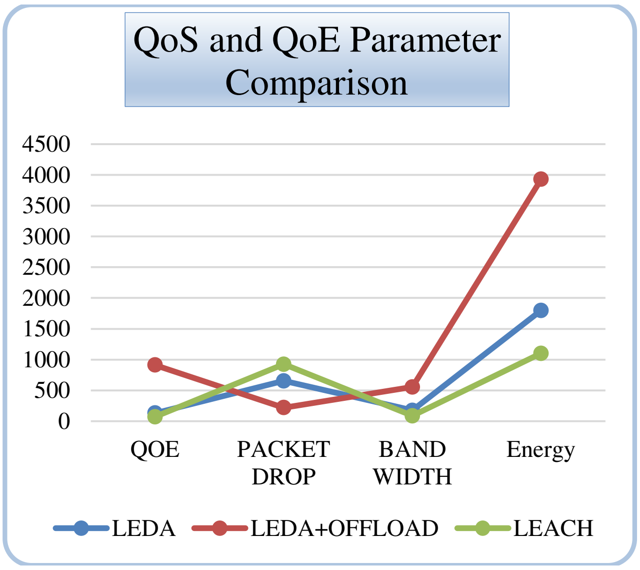


Figure-7. QoS and QoE parameter comparison graph.

Study touches all the factors considered in the QoS and introduced a new concept of QoE the Quality of the Experience of h.

CONCLUSION AND FUTURE SCOPE

Research work proposes a novel methodology which can efficiently do the operation of collecting data from various heterogeneous sensor nodes and process the data and store it. Efficient collection of data is carried out through grouping sensor nodes in to cluster and then a cluster head is selected who take control of the communication, there will multiple Data node associated to cluster to improve data collection efficiency. The inclusion of the QoS and QoE parameter in offload criteria have greatly helped to improve life time network as well as performance. Thus, the system and its inbuilt algorithms together give an efficient energy saving communication and data collection network for wireless sensor nodes. The system can be further improved by considering the experience of user and sensor-based application running in the network.

REFERENCES

[1] G. Wittenburg and N. Dziengel. 2010. A system for distributed event detection in wireless sensor networks. Proc. 9th conference. pp. 94-104.

[2] S. Ehsan and B. Hamdaoui. 2012. A survey on energy-efficient routing techniques with QoS assurances for wireless multimedia sensor networks. IEEE Communications Surveys and Tutorials. 14(2): 265-278.

[3] A. Yektaparast, F. H. Nabavi and A. Sarmast. 2012. An improvement on LEACH protocol (Cell-LEACH). Adv. Commun. Technol. (ICACT), 2012 14th Int. Conf. pp. 992-996.

[4] W. Wang, Q. Wang, W. Luo, M. Sheng, W. Wu and L. Hao. 2009. Leach-H: An improved routing protocol for collaborative sensing networks. in 2009 International Conference on Wireless Communications and Signal Processing, WCSP 2009.

[5] Y. Lv and Y. Tian. 2010. Design and application of sink node for Wireless Sensor Network. In: 2010 2nd International Conference on Industrial and Information Systems, IIS 2010. 1: 487-490.

[6] J. Wu, S. Yuan, S. Ji, G. Zhou, Y. Wang and Z. Wang. 2010. Multi-agent system design and evaluation for collaborative wireless sensor network in large structure health monitoring. Expert Syst. Appl. 37(3): 2028-2036.

[7] Y. Lim and J. Park. 2014. Sensor resource sharing approaches in sensor-cloud infrastructure. Int. J. Distrib. Sens. Networks. Vol. 2014.

[8] A. Mukhopadhyay, K. S. Subeesh, and S. Mathew. 2015. Context aware information for localization. Int. J. Appl. Eng. Res. 10(55): 1938-1942.

[9] D. Takaishi, H. Nishiyama, N. Kato and R. Miura. 2014. Toward energy efficient big data gathering in densely distributed sensor networks. IEEE Trans. Emerg. Top. Comput. 2(3): 388-397.

[10] M. A. J. J. Mortaza Fahimi Khaton Abad. 2011. Modify LEACH Algorithm for Wireless Sensor Network. Int. J. Comput. Sci. 8(5): 219-224.

[11] Y. Bao, L. Ren, L. Zhang, X. Zhang, and Y. Luo. 2012. Massive sensor data management framework in cloud manufacturing based on Hadoop. IEEE Int. Conf. Ind. Informatics. pp. 397-401.

[12] N. S. Islam, M. Wasi-Ur-Rahman, X. Lu, D. Shankar and D. K. Panda 2015. Performance characterization and acceleration of in-memory file systems for Hadoop and Spark applications on HPC clusters. Proc. 2015 IEEE Int. Conf. Big Data, IEEE Big Data 2015, pp. 243-252.

[13] S. Misra, S. Chatterjee and M. S. Obaidat. 2014. On Theoretical Modeling of Sensor Cloud: A Paradigm Shift From Wireless Sensor Network. IEEE Syst. J. pp. 1-10.

[14] H. Ochiai, H. Ishizuka, Y. Kawakami and H. Esaki. 2011. A Delay-Aware Data Collection Network Structure for Wireless Sensor Networks. IEEE Sens. J. 11(3): 699-710.

[15] An IOT-enabled System for Marine Data Aquisition and Cartography. 2017. R. Al-Zaidi, J. Woods, M. Al-Khalidi, and H. Hu. An IOT-enabled System for Marine Data Aquisition and Cartography. Trans. Networks Commun. 5(1): 53.

[16] A Novel Sensory Data Processing Framework to Integrate Sensor Networks with MobileCloud. 2014. C. Zhu, H. Wang, X. Liu, L. Shu, L. T. Yang, and V. C. M. Leung. A Novel Sensory Data Processing Framework to Integrate Sensor Networks With Mobile Cloud. IEEE Syst. J. 99: 1-12.

[17] Smart cities built on resilient cloud computing and secure internet of things. 2013. G. Suciu, A. Vulpe, S. Halunga, O. Fratu, G. Todoran, and V. Suciu. Smart cities built on resilient cloud computing and secure internet of things. Proceeding of 19th Int. Conf. Control Syst. Comput. Sci. CSCS 2013. pp. 513-518.

[18] Density and mobility impact on MANET routing protocols in a maritime environment. R. J. Mohsin, J. Woods, and M. Q. Shawkat. 2015. Density and mobility impact on MANET routing protocols in a maritime environment. Proc. 2015 Sci. Inf. Conf. SAI 2015. pp. 1046-1051.

[19] Design of radio transmission technologies for VHF band ship ad-hoc network. 2011. B. Hui, K. H. Jeon, K. H. Chang, S. G. Kim, J. W. Park, and Y. K. Lim. Design of radio transmission technologies for VHF band ship ad-hoc network. 2011 Int. Conf.ICT Converg. ICTC 2011, pp. 626-629.

[20] Integration of Cloud computing and Internet of Things: A survey, Futur. 2016. A. Botta, W. De Donato, V. Persico and A. Pescapé. Integration of Cloud computing and Internet of Things: A survey, Futur. Gener. Comput. Syst. 56: 684-700.

[21] 2014. Enabling Smart Cloud Services through Remote Sensing : An Internet of Everything Enabler S. Abdelwahab, B. Hamdaoui, and S. Member, Enabling Smart Cloud Services through Remote Sensing: An Internet of Everything Enabler. 1(3): 276-288.

[22] IoT and Cloud Convergence: Opportunities and Challenges. A. R. Biswas and R. Giaffreda. 2014. IoT and Cloud Convergence: Opportunities and Challenges, 2014 IEEE World Forum Internet Things. pp. 375-376.

[23] CloudThings: A common architecture for integrating the Internet of Things with Cloud Computing. J. Zhou *et al*. 2013. CloudThings-A common architecture for integrating the Internet of Things with Cloud Computing. Proc. 2013 IEEE 17th Int. Conf. Comput. Support. Coop. Work Des. CSCWD 2013, pp. 651-657.

[24] Dustdar, Efficient and scalable IoT service delivery on cloud. F. Li, M. Voegler, M. Claessens, and S. Dustdar. 2013. Efficient and scalable IoT service delivery on cloud, IEEE Int. Conf. CloudComputing. CLOUD. pp. 740-747.

[25] S. Manishankar, P. R. Ranjitha and M. K. T. 2017. Energy Efficient Data Aggregation in Sensor Network Using Multiple Sink Data Node. IEEE Conf. Int. Conf. Commun. Signal Process. pp. 448-452.