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IMPROVED LOAD BALANCING USING CIRCULATED MOBILITY ADAPTIVE COMMUNICATION TUNING ALGORITHM IN MOBILE AD-HOC NETWORKS (MANETs)

Dr. D.Sampath Kumar
Associate Professor, Department of Information Technology,
Sri Ramakrishna College of Arts & Science, Coimbatore, Tamil Nadu, India.

Abstract

MANETs are framework less networks, powerfully shaped by an autonomous arrangement of portable mobile nodes that are associated by means of wireless connections. Since routing is performed by nodes with restricted resources, load ought to be effectively appropriated through the network. Else, intensely stacked nodes may make up a bottleneck that brings down the mobile network performances by delays and congestion. Unfortunately, load-balancing is a critical insufficiency in MANETs, as nodes at the center point of the network are much intensely stacked than the others. Consequently, we propose, in this work, improved line-balancing through circulated mobility adaptive communication tuning (CMACT) that pushes the network traffic from the center of the network. Fundamentally, we give novel routing measurements that consider nodes level of centrality, for both proactive and responsive routing protocols. Simulation demonstrates that the proposed components enhance the load distribution and essentially upgrades the network efficiency as far as the reliability and the delays are concerned.

Key words: MANETs, CMACT, Load-Balancing, Routing, Protocols, network efficiency

1. INTRODUCTION

Mobile Ad Hoc Networks (MANETs) are continuously self-configuring and infrastructure-less networks of mobile phones which are connected wirelessly. Due to their adaptability and rapid advances in technology, MANEThave gained noticeable growth in this decade. Manet is an assortment of mobile and wireless sensor nodes. They have a wide range of applications due to their adjustable and in-expensive attributes [1]-[3]. In MANET, each nodes, which are autonomous in behavior, acts as both host and router. These nodes are capable of arbitrary movement with the freedom to enter or withdraw from a network independently. Each of the nodes also has the work of maintaining CPU capacity, storage capacity, bandwidth and battery power [4]. Each of the mobile nodes carries a battery with limited power which in turn limits the processing power, thus limiting the services and applications supported by each of the nodes[5]. The transmission in a MANET takes place through Multi-hops as they may contain one or multiple and different transceivers between nodes [2]. This transmission results in a highly dynamic, autonomous topology. The network topology in the ad hoc wireless sensor consisting of a set of nodes keeps changing randomly and hence a variety of routing protocols are proposed.

The transmission of packets in the network happens through routing protocols and however, when there are only two nodes which are located very closely in a network then there is no need for any routing protocol since the transmission can happen directly between the nodes. With a cluster of nodes in the network, transmission of packets occurs through certain protocols that come into play as there exists some complications for the nodes to carry out the data packets from the source node to the destination node. Since the nodes act on battery power the data packets to be transmitted should be sent through an optimal route to perpetuate efficiency. Looking out for an ideal routing protocol for MANET, the nodes should be evenly distributed as centralized routing engages high control overhead and will not be scalable. The routing protocols should be adaptive to frequent topology changes induced by the mobility of the nodes and it should also be from loops and state routes. There must be a minimum number of nodes during the route computation and maintenance with each node having quick access routes, i.e. minimum connection setup time is desired. The protocol must optimally use scanty resources such as bandwidth, memory, computing power and battery. The number of packet collisions happening in the network should be kept low by restraining the number of broadcasts made by each nodes. The transmission happening in the network should be reliable to reduce the loss of messages and also prevent the occurrence of state routes. The protocol being used should be able to afford a certain level of Quality of Service (QoS) as demanded by the applications and should also attempt for time-sensitive traffic [1-5].

The routing protocols for ad hoc sensor networks are broadly prorated into four sections such as Routing information update mechanism, Routing topology, Use of temporal information for routing, Utilization of specific resources.Ad hoc routing protocols can be classified into Pro-active or table driven routing protocol, Reactive or on-demand routing protocol and Hybrid routing protocol. Pro-active or table driven routing protocol periodically exchanges routing information that every node maintains at the network topology information in the form of routing tables so that whenever a node requires a destination's path it runs an appropriate path-finding algorithm on the topology that maintains the information. The routing information is generally flooded in the whole network area. Unlike Pro-active protocol Reactive protocol do not maintain any routing table information and whenever a node needs a path to transmit data packets, by using connection establishment process the protocol generates a path for the node to transmit data. Hybrid routing protocol combines the best features from the above two routing protocols and achieves efficiency. Table-Driven protocols are the extension of the wired network routing protocols that maintain the global topology information in the form of tables at every node. Routing protocols that exists in Table-Driven routing protocols are Destination Sequenced Distance Vector routing protocol (DSDV), Wireless routing protocol (WRP), Source-Tree Adaptive routing protocol (STAR), Cluster-Head Gateway Switch routing protocol (CGSR). These protocols are used to carry out transmission when the data packets are evenly distributed in the network and when the data packets distributed are uneven it leads to a bottle-neck shape ate the top of the network. Hence, leading to congestion in the network. To maintain packet transmission flow inside the networkwith heavily added nodes Improved Load Balancing using Circulated Mobility Tuning algorithm can be used which reduces the congestion and makes the data transmission facile [1-5].

2. RELATED WORKS

There are a lot of articles, which investigate the load balancing (LB) issues of networks. To balance load among cells, control calculations were proposed in [6], which have lessened the transmission energy to contract the scope of substantial payload cells. By controlling shaft, scope examples of "normal signals," sizes, and states of cells can be consequently changed in accordance with adjust cell stack [7]. In [8], the cell in a network, particularly counterbalance was balanced naturally in the view of payloads of the source cell and the neighboring cells. A two-layer LB calculation was discussed in [9], where the over-burdened cell can pick an objective cell by considering the circumstance of its two layer encompassing cells. [10] Had chosen a proper LB strategy from handover parameter control and cell coverage control as indicated by the circumstance. To adapt to the potential ping-pong stack exchange and low merging issues, creators in [11] proposed a theoretic answer for their LB scheme. In [12], a multidomain LB system was proposed, which centers on decreasing the radio asset cost and moderating the cochannel impedance crosswise over spaces in the heterogeneous system. In [13], creators proposed a genetic self-enhancing technique for LB. In the technique, first the load of all cells is assessed; at that point a few clients are chosen to be given over to the neighbor cells as indicated by the incitement power of all clients in the cell. However, nothing from what was just mentioned explores breaks down either the ideal target cell for a vigorously stacked cell or the ideal number of clients that ought to be exchanged between two cells. There are a lot of articles which examines remote system through a Markovian model. In [14], the blocking likelihood of various sorts of administration in a system is figured. [15] Played out a stochastic execution investigation of a limited state Markovian channel shared by various clients and inferred postponement and excess upper limits in light of the expository standard behind stochastic system math.

3. SYSTEM IMPLEMENTATION

Load Balancing

In a dedicated environment when load unbalancing arises in a distributed system, then the processors with heavy loaded computers are drifted to the computers with under load. But in a non-dedicated environment, computers tend to be heterogeneous and owned privately. Privately owned states that the machine can be used for collaborative processing on-demand. Counteraction for computing resources does not lead to assured high performance whereas stealing computing cycles is more adequate method to outstand parallel processing rather than counteracting for computing cycles in a distributed and non-dedicated parallel environment. Process migration is an assuring solution the concept of cycle stealing. Process migration is further productive for the utilization of collaborative processing with idle machines. This phase approves a thorough detail about the anticipated CMACT-ILB based algorithm. There exists three modules in the CMACT-ILB and they are

1. Measure the cluster member node's load.
2. Improved Load Balancing method.
3. Circulated Mobility Adaptive Tuning algorithm.

Measuring the cluster member node load:

The cluster's load should be sustained evenly and if not sustained then there occurs a bottleneck formation at the ends of the nodes due to congestion. Congestion in a cluster occurs when the head node selected cannot transmit the load in the network.

Algorithm for Improved Load Balancing:

```
Step 1: Measure the cluster member load.
Step 2: Analyze the individual heavy load for each node.
Step 3: if(node == max load) then
Step4: load does not balance
Step 5: Packet flood occurs during the communication period.
Step 6: One member from the network perform two cluster communications.
Step 7: else if(node == min load)
Step 8: load balancing
Step 9: Packet does not flood during communication period.
Step 10: One member perform single cluster communication.
Step 11: end if
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Algorithm for Circulated Mobility Adaptive Communication Tuning

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SCC - Single Cluster Communication.
Step 1: for each sender search various cluster node
Step 2: if(scc == communication does not tune)
Step 3: Efficient packet organization.
Step 4: Reduces energy consumption.
Step 5: else if(scc == communication tuning)
Step 6: tuning single node for cluster communication
Step 7: end if
Step 8: Increased packet delivery ratio.
```

Packet format

The packet formats have been shown in figure 1. It epitomizes the packets involved by each field. First and second fields are source node and destinationnode IDs, which takes 4 bytes. Third field is Source node, which examines the routing path, which takes 3 bytes. Once in the past, an upgraded trust depending bunch correspondence field and it receipts 3 bytes for successful multipoint get to. Fifth field is Multi point get to streamlining technique and it takes 2 bytes for analyzing the calculation. Extreme recorded is Lessened use way is assigned and it takes 2 bytes.

Source ID	Destination ID	Source node analyze routing path	Improved load balancing	CMACT algorithm	Minimized usage path is selected
4	4	3	3	2	2

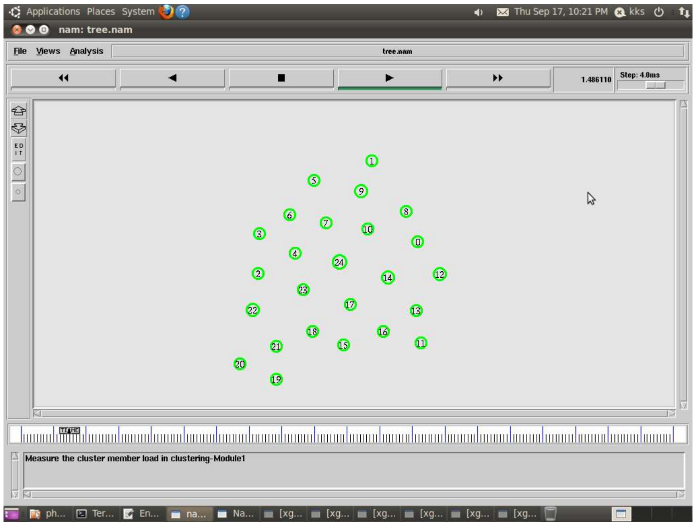
Figure 1: Packet format for presented protocol

4. RESULTS AND DISCUSSION

To improve the load balancing in a MANET using CMACT-ILB protocol. The authentication of the proposed CMACT-ILB protocol is implemented using NS-2 simulator for analyzing its load balancing capabilities. The technique was demonstrated in a network with an example of 100 nodes via network simulator. Desired outputs were attained, and the graphs are plotted to relate the results of the proposed CMACT-ILB Methodology, which demonstrates the rapid improvement of the load balancing. The proposed methodologies performance was analyzed by means of its metrics and they are; energy utilization, Packet Delivery Ratio, communication overhead, failure detection efficiency, network lifetime and end-to-end delay.

Table 1 shows the simulation parameters and their values

Parameters	**Values**
No. of Nodes	100
Area Size	1000 X 1000
Mac	802.11g
Radio Range	250m
Simulation Time	20 - 250ms
Traffic Source	FTP
Packet Size	512 bytes
Mobility Model	Random Way Point

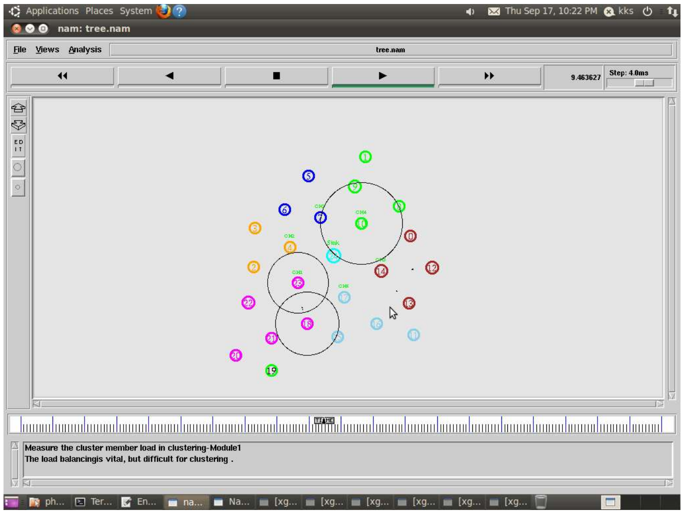


Measure the cluster member load in clustering-Module1

Figure 2. Shows the stronger nodes taken in the cluster of a network.

Figure 2. Shows the stronger nodes that are taken into consideration for the transmission of the data packets. In the previous versions such as Improved Trust Depending Cluster Communication Using Multi Point AccessOptimization Algorithm in MANET and Novel Clustering Based Routing Approach in Manetby Flower Pollination Algorithm the nodes are taken directly for network simulation without knowing the node strength whereas in ILB using CMACT algorithm the stronger are considered and taken in the cluster of the network for

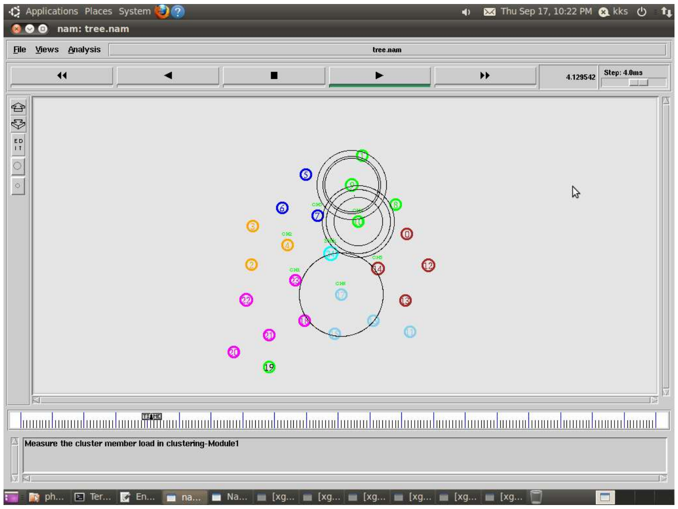
communication, so, that the packets are transmitted without any congestion due to the low power nodes.



Measure the cluster member load in clustering-Module1
The load balancingis vital, but difficult for clustering .

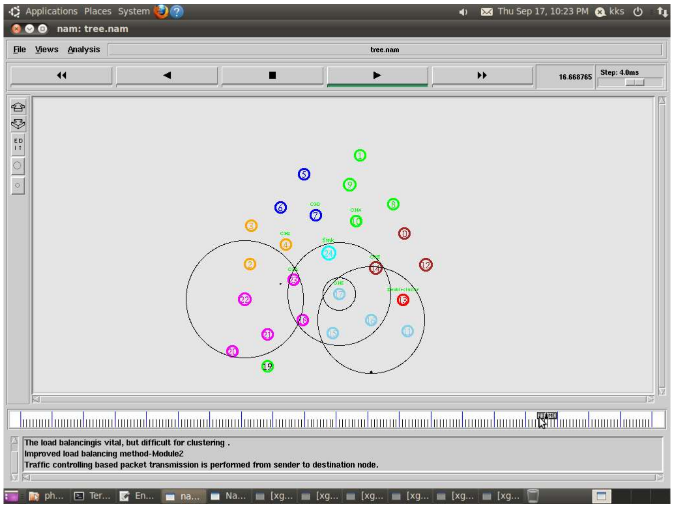
Figure 3.Shows the Network selection.

Figure 3.shows the network simulation phase that takes place in the ILB using CMACT. The previous versions take various hundreds of nodes to transmit the data packets whereas in ILB using CMACT, only the stronger nodes are taken into consideration and these nodes do not cause congestion which leads to imbalancing in the transmission pipeline.



Measure the cluster member load in clustering-Module1

Figure 4.Shows the Network Simulation of Improved Load Balancing using Circulated Mobility Adaptive Communication Tuning algorithm.



The load balancingis vital, but difficult for clustering .
Improved load balancing method-Module2
Traffic controlling based packet transmission is performed from sender to destination node.

Figure 5.Shows the selected nodes for packet delivery from the cluster in the network

CLASSIFICATION OF RESULTS BASED ON ITS METRICS

Node vs. Energy

It is the aggregate sum of energy utilized by all the nodes in a MANET during simulation time at three diverse network layers that is, Application layer, Network layer and MAC. The energy estimation due to each action of receive, send, forward and drop by each and every node can be acquired by a summation of energy devoured in all task modes. The energy utilization is exhibited in equation (1), where i is the hub number and n is the aggregate number of the mobile node. Figure 5 shows the computed trust values of the senor nodes average.

$$Overall\_Energy = \sum_{i=0}^{n-1} (Energy\_Consumed\_by\_Node(i)) \qquad (1)$$

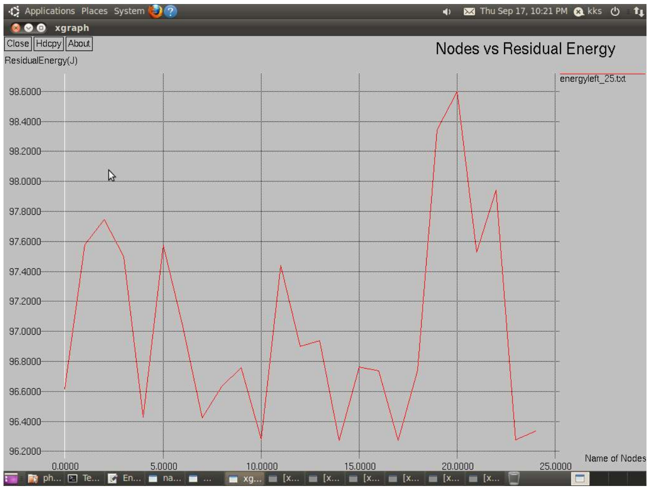


Figure 6 Computed trust values of the sensor nodes average.

Network Lifetime

The network lifetime is an efficiency metric of a network. Here the network lifetime (%) is computed for different algorithms and tabulated in Table. 2.

Table. 2. Network Lifetime (%)

Speed(ms)	**Network lifetime (%)**				
	TBTA	**EEO**	**ITCC**	**EESC**	**CMACT-ILB**
40	28	39	80	83	87
80	29	40	81	84	88
120	31	41	83	85	89
160	32	42	84	87	90
200	33	43	85	88	91

The improved load balancing scheme works with maximum network lifetime efficiency than the existing systems, the values are tabulated for different pause time ranges from 40 to 200ms and the computed percentages are speed (40 ms) → 87%; speed (80 ms) → 88%; speed (120 ms) → 89%; speed (160 ms) → 90%; & speed (200 ms) → 91%; respectively.

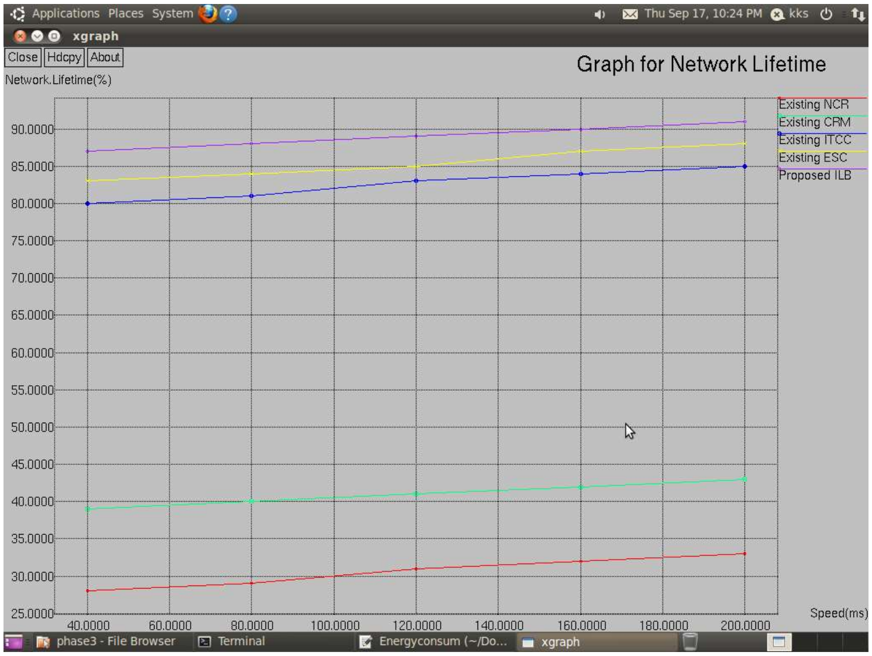


Figure 7.Shows the total lifetime of the network

The computed values are plotted for the existing schemes (TBTA, EEO, ITCC, and EESC) vs. the proposed scheme (CMACT-ILB). As shown in figure. 7.

Packet Delivery

Here the packet delivery ratio is computed for different algorithms and tabulated in Table. 3. The improved load balancing scheme works with efficient packet delivery ratio, the values are tabulated for a set of nodes ranges from 20 to 100 and the computed packet delivery ration in (%) and they are as follows (Set of 20 nodes) → 86%; (Set of 40 nodes) → 88%; (Set of 60 nodes) → 89%; (Set of 80 nodes) → 90%; & (Set of 100 nodes) → 91% respectively.

Table. 3. Packet Delivery Ratio (%)

Nodes	**Packet Delivery ratio(%)**				
	TBTA	**EEO**	**ITCC**	**EESC**	**CMACT-ILB**
20	34	55	79	82	86
40	35	56	80	83	88
60	37	57	81	85	89
80	38	58	83	86	90
100	39	59	84	87	91

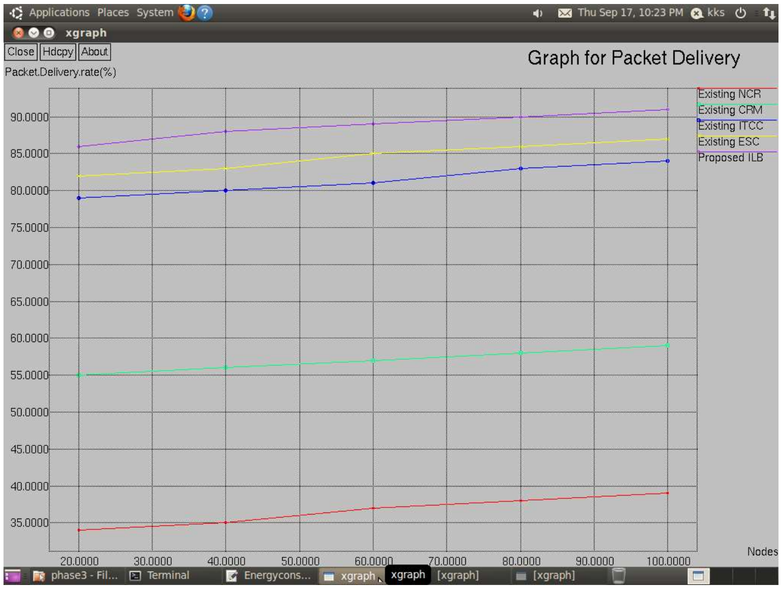


Figure 8.Shows the packet delivery ratio of the nodes in the network.

The computed values are plotted for the existing schemes (TBTA, EEO, ITCC, and EESC) vs. the proposed scheme (CMACT-ILB). As shown in figure. 8.

End to End delay

The end to end delay is an average of over all data packets, which are surviving from the source to the target destination. Here the end to end delay is computed for different algorithms and tabulated in Table. 3.

Table. 3. End to End Delay (Sec)

Pause time(ms)	**End to end delay(sec)**				
	TBTA	**EEO**	**ITCC**	**EESC**	**CMACT-ILB**
20	22.40	29.45	10.63	8.03	6.14
40	23.15	30.10	11.45	9.56	7.35
60	24.09	31.28	12.07	10.83	8.70
80	25.72	33.66	13.80	11.95	9.32
100	26.88	34.79	14.92	12.35	10.04

The improved load balancing scheme works with minimum source to the target delay, the values are tabulated for different pause time ranges from 20 to 100ms and the computed end to end delays are pause time (20 ms) → 6.14s; pause time (40 ms) → 7.35s; pause time (60 ms) → 8.70s; pause time (20 ms) → 9.32s; & pause time (20 ms) → 10.04s respectively.

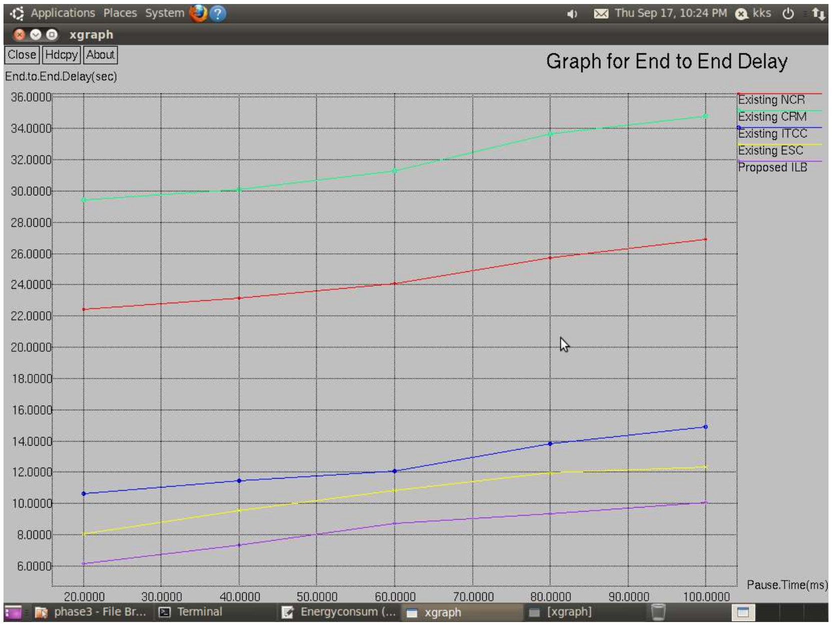


Figure 9.Shows the end to end delay in the network

The computed values are plotted for the existing schemes (TBTA, EEO, ITCC, and EESC) vs. the proposed scheme (CMACT-ILB). As shown in figure. 9.

Energy Consumption

Here the Energy consumption is computed for different algorithms and tabulated in Table. 4. The improved load balancing scheme works with maximum efficiency, the values are tabulated for a set of nodes ranges from 20 to 100 and the computed Energy consumption in (J) are as follows (Set of 20 nodes) → 98J; (Set of 40 nodes) → 104J; (Set of 60 nodes) → 111J; (Set of 80 nodes) → 119J; & (Set of 100 nodes) → 126J respectively.

Table. 4. Energy Consumption (J)

Nodes	**Energy consumption (J)**				
	TBTA	**EEO**	**ITCC**	**EESC**	**CMACT-ILB**
20	254	200	160	122	98
40	260	208	168	130	104
60	271	224	176	142	111
80	280	236	187	156	119
100	289	242	192	164	126

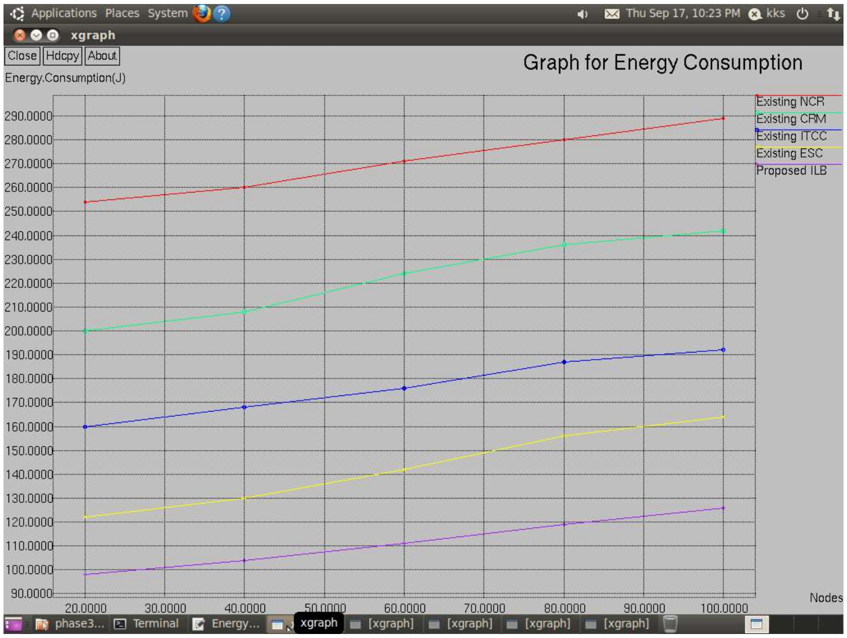


Figure 10. Shows the Energy consumed by the nodes during the transmission of the packets.

The computed values are plotted for the existing schemes (TBTA, EEO, ITCC, and EESC) vs. the proposed scheme (CMACT-ILB). As shown in figure. 10.

Packet Loss Rate

Here the packet loss rate is computed for different algorithms and tabulated in Table. 5. The improved load balancing scheme works with efficient packet delivery ratio, the values are tabulated for a set of nodes ranges from 20 to 100 and the computed packet loss rate in (%) and they are as follows (Set of 20 nodes) → 18%; (Set of 40 nodes) → 19%; (Set of 60 nodes) → 21%; (Set of 80 nodes) → 22%; & (Set of 100 nodes) → 23% respectively.

Table. 5. Packet Loss rate (%)

Nodes	**Packet loss rate (%)**				
	TBTA	**EEO**	**ITCC**	**EESC**	**CMACT-ILB**
20	68	44	22	20	18
40	69	45	23	21	19
60	71	47	24	22	21
80	72	48	26	23	22
100	73	49	27	24	23

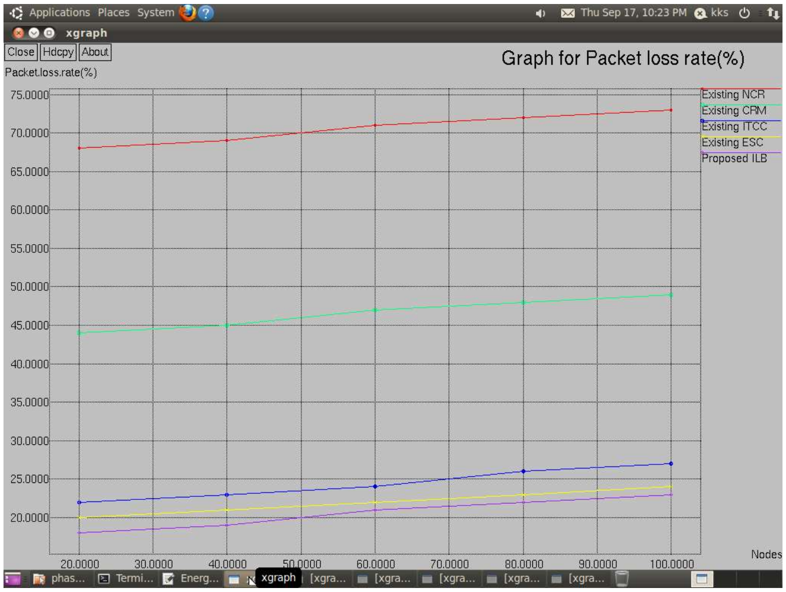


Figure 11.Shows the loss of packets in percentage during the transmission between the nodes in the cluster

The computed values are plotted for the existing schemes (TBTA, EEO, ITCC, and EESC) vs. the proposed scheme (CMACT-ILB). As shown in figure. 11.

Failure Detection Efficiency

Here the failure detection efficiency is computed for different algorithms and tabulated in Table. 6. The improved load balancing scheme works with efficient Failure detection efficiency (%), the values are tabulated for a set of nodes ranges from 20 to 100 and the computed packet loss rate in (%) and they are as follows Mobility (10bps) → 86%; Mobility (20bps) → 87%; Mobility (30bps) → 88%; Mobility (40bps) → 89%; & Mobility (50bps) → 90%; respectively.

Table. 6. Failure detection efficiency (%)

Mobility(bps)	**Failure detection efficiency (%)**				
	TBTA	**EEO**	**ITCC**	**EESC**	**CMACT-ILB**
10	26	40	78	81	85
20	28	42	79	82	87
30	29	43	80	83	88
40	30	44	81	84	89
50	31	45	82	86	90

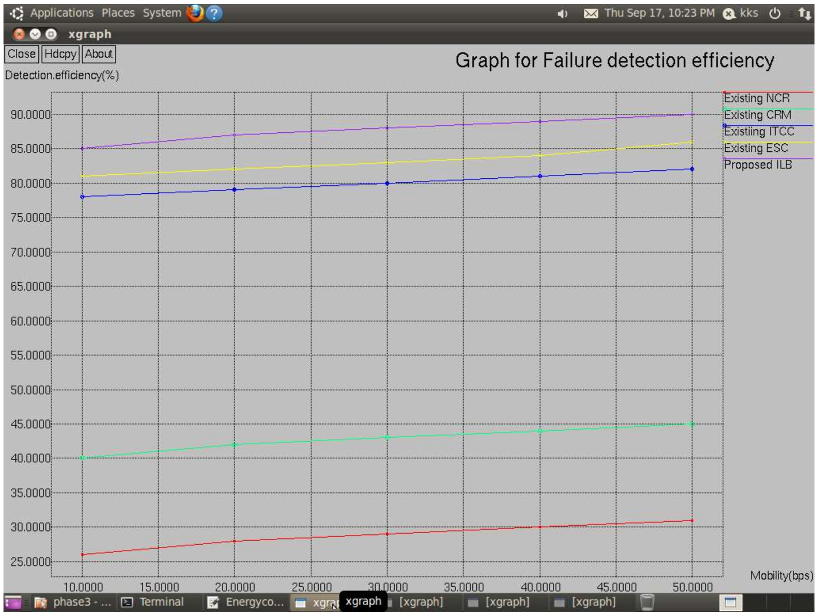


Figure 12. Shows the graph for failure detection efficiency between the nodes in the cluster of the network.

The computed values are plotted for the existing schemes (TBTA, EEO, ITCC, and EESC) vs. the proposed scheme (CMACT-ILB). As shown in figure 12.

5. Conclusion

In this paper we have proposed an improved load balancing algorithm for maintaining efficient load balancing in a network to avoid congestion and overall efficiency affecting parameters, the proposed scheme (CMACT-ILB) outperforms the existing LB schemes (TBTA, EEO, ITCC, and EESC) in the quality metrics like network lifetime, packet delivery ratio, end to end delay, Energy consumption, packet loss rate, and Failure detection efficiency. Proposed technique (CMACT-ILB) produces maximum efficiency in all the quality parameters, which were discussed above.

Conflict of Interests

No potential Conflict of interests and it is declared none.

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