International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Optimized Load Balancing Mechanism Using Carry Forward Distance

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Abstract*: Wireless sensor networks are basically a collection of devices which are inexpensive and are capable of communicating, sensing as well as computation. A wireless sensor network consists of a large number of nodes that are scattered in a network. MANET is a kind of ad-hoc network. MANET'S that is mobile ad-hoc networks have possibility of communicating in set of low cost and low power sensing devices. All the nodes in the MANET are allowed to move freely in any direction. There are two major concerns that come in consideration while talking about MANET'S:- 1) energy 2) bandwidth.. Load balancing in such condition is a selection of optimization path that are economical and does not allow the structure to break down. The main focus in our research is to reduce overhead and increase the throughput with the load balancing schemes in the network..Our research is based on the concept of producing better solutions for overhead reduction in wireless networks by providing load balancing schemes. The performance has also been analysed. The main focus in this research is to reduce overhead and increase the throughput with the load balancing schemes in the network.*

Keywords: Mobile ad-hoc networks, routing protocols, load balancing routing protocols, comparison.

1. Introduction

1.1 Wireless Sensor Networks

In the recent world the WSN (Wireless Sensor Networks) are of much importance. These are basically collection of devices which are inexpensive and are capable of communicating, sensing as well as computation.

1.1.1 A wireless sensor networks uses 3 kinds of topologies

1. Point-to-point
2. Star
3. Mesh

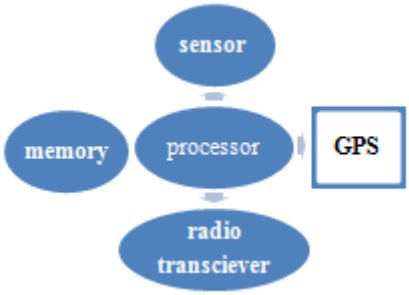
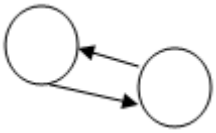
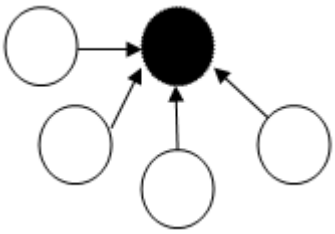


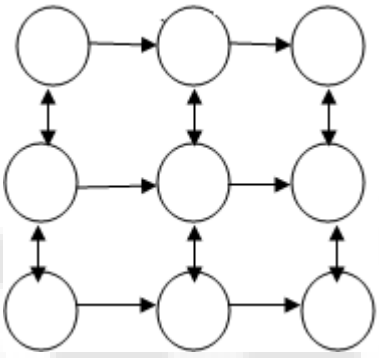
Figure 1: Wireless Sensor Network



1) point-to-point



2) Central master node



3) Mesh

Figure 2: Topologies used in WSN

Many master nodes can combine to form a larger network called *clustered networks*.

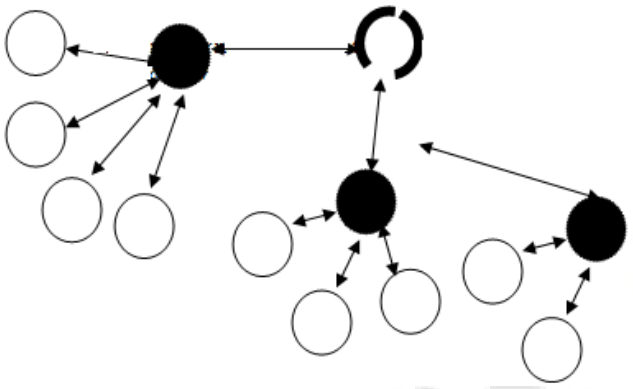


Figure 3: Clustered Networks

1.1.2 Properties of WSN

a. Provides a bridge between real physical and virtual worlds
b. Provides a wide range of applications to industry, transport, security and civil infrastructure.
c. Provides ability to observe the scenarios that are not observed earlier at a finer solutions.

1.1.3 Comparison with ad-hoc networks.

a. Data and address centric
b. Resources such as memory, power,processing are limited
c. Number of nodes are larger
d. More prone to failure
e. No unique global ID's

1.2 Mobile Ad_Hoc Networks

It is a infrastructure less and self configuring network of mobile devices without any wired link. Each node is independent to move in this network in any direction and therefore it is possible for nodes to change its links frequently.

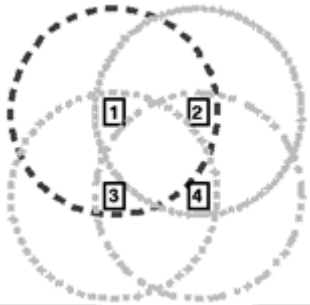


Figure 4: Mobile Ad-Hoc Networks

Node 1 and node 3 are not in connection with each other whereas communication can be done through node 2. Node 2 will act as a router and these 3 nodes form a mobile ad-hoc network.

1.2.1 Characteristics of MANET'S

a. Light weighed terminal: - because the nodes in MANET'S are mobiles that have low power storage, less cpu capability and small memory utilization so they are light weighed terminals.
b. Shared physical medium :- the medium of communication is shared which means that it is accessible with appropriate equipment and adequate resources.
c. Multi hop routing: - when one node sends the data to another node which is not in the range then the message should be send through some other intermediate node.
d. Distributed operation: - no central node in the network means that the nodes involved in this network should communicate with one another.
e. Dynamic topology: - the nodes are free to move anywhere at any speed. The nodes in MANET'S dynamically route themselves establishing a network.
f. Independency: - each node is independent and so acts as both host and a router.

1.2.2 Challenges in MANET'S

a. Manets have limited bandwidth
b. MANET'S have dynamic topology.
c. Nodes keep on increasing the overhead by changing their routes in the network.
d. There is a lot of packet loss due to transmission errors.
e. Devices used in these networks have restriction on the power source in order to maintain probability, size and weight on the device.

1.2.3 Applications of MANET'S

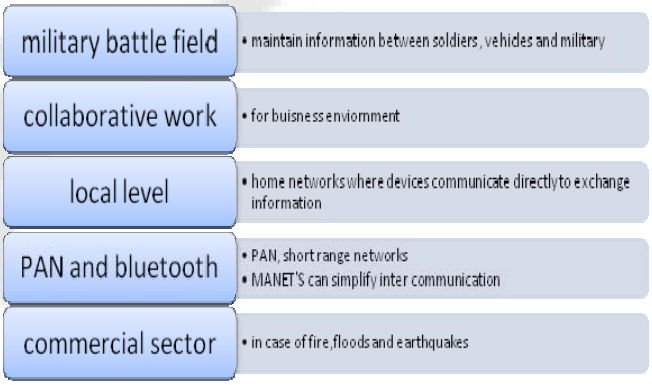
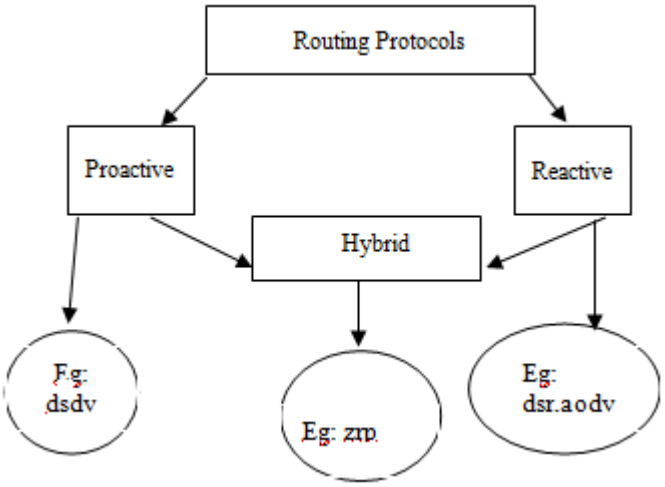


Figure 5: Applications of MANET'S

1.2.4 Routing Protocols used in MANET'S



1) Proactive Routing Protocols:- in this type of routing protocol the nodes maintain a tabular information about the routing between the nodes . any changes in the routing should be propagated through network to maintain a consistent view.
   Eg – destination sequenced distance vector
   Advantages – minimizes the delay and allow nodes to quickly determine which nodes are reachable in the network.
2) Reactive Routing Protocols: - in this scenario no routing table is maintained where as it is 'on-demand' routing. The nodes establish a connection route only when it needs to deliver a packet that is on demand.
   Eg- DSR and ADOV

2. Load Balancing

When the packet is send through a network it travels through multiple nodes so as to reach the destination from the source node. The scenario says that supposing a flood of packets comes and the existing path for data flow is busy then we will have to re-route the packets through another set of nodes. This technique is called as load balancing technique. Suppose there are many alternate paths to be choosen for sending the packets and on route discovery the same path is chosen then a problem of packet loss occurs. Here we will need to balance the load on the network.

2.1 Classification of load balancing protocols in MANET'S

Most of the routing protocols in MANET'S are reactive ie 'on-demand' routing protocols. This includes the load balancing strategies with the route discovery phase. Load can be seen as:-

a) Nodal load- it means the amount to which a node is busy while processing.
b) Channel load- it means the load on the channel
c) Neighborhood load- it means the load generated because of communicating activities.

2.2 Metrics used for load

a) Active path- it refers to the number of active routing paths supported by a node. The higher the number, the busier network it is.
b) Traffic size- traffic load on the node and its associated neighboring node is the traffic size.
c) Node delay- for the transmission of packets from source to destination is called node delay
d) Channel access probability- it refers to the likelihood of success in accessing a wireless media.
e) Packet in interface queue- it refers to the total number of packets buffered both at incoming and outgoing interfaces.

2.3 Categories of load balancing protocols

1) Delay based routing protocols: - they are used when we reduce the link delay in load balancing.
2) Traffic based routing protocols: - they are used by distributing the traffic on the nodes evenly.
3) Hybrid based routing protocols: - it is the combination of both the above.

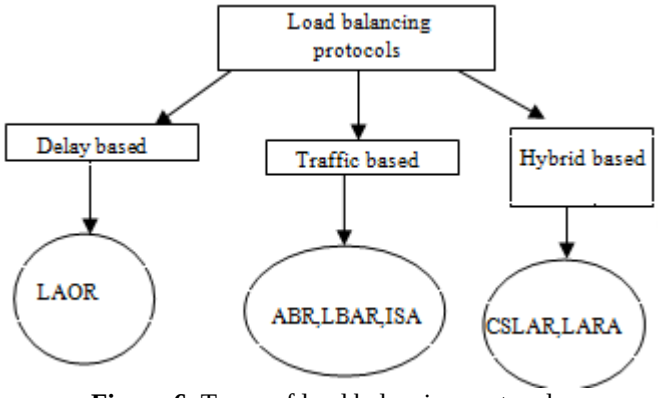


Figure 6: Types of load balancing protocols

3. Proposed Work

As wireless resources are precious, the efficiency of wireless networks becomes a crucial issue. One way to measure efficiency is to ascertain whether system resources are used evenly or fairly. If evenness and fairness are lacking in a wireless Ad Hoc network, some nodes in the network may take on some extra work in relaying packets for other nodes. The transmission of their own communication will be affected and the battery life of these nodes will be shortened. The latter case will lead to more topology changes, because the node goes down once the battery is exhausted. If all users share system resources fairly and provide service to other users fairly, wireless Ad Hoc networks can provide an efficient solution for communications. Meanwhile, when traffic load goes up in a wireless Ad Hoc network, some areas become congested while other areas are in an idle state. Thus, a new solution must be sought to explore those underutilized resources, without losing the virtues of routing protocols that support the dynamic environment of the system.
As routing protocols such as DSR are reactive routing protocols, the routing overhead is lower compared to other types of protocols, especially when the topology changes frequently. To support such a diversified range of services, better quality in routing, security and load balancing are required. Load balancing the traffic is the main function to which this research will focus.

This research will tends to eliminate the problem of load balancing in WSN networks in term of congestion. Research will provide a distributed load balancing scheme to share the load on the devices. Further will focus on reducing delay by providing quality on individual devices and then for whole network.

This research will focus on providing solution for said problem by enhancing quality of service between nodes so that network will have better throughput and less delay.This research will be focused on the load balancing in a most distributed way possible to avoid the congestion in WSN.

PHASES

1. Research will start with building a WSN network in Network simulator with parameters like HTTP, FTP, VIDEO CONFERENCE traffic, variation of nodes and servers, particular energy level of sensor nodes. Basic

parameters like Packet delivery, Throughput, Delay, Retransmission Attempt, Network Load for WSN will be used.

2. After basic building and implementation of WSN networks, a scenario with congestion will be implemented. Both scenarios will be compared on the bases of parameters like throughput, Packet delivery ratio, end to end delay and network load.
3. To avoid the Congestion, proposed distributed load balancing will be done by implementing the WSN in similar line to content delivery networks.
4. Proposed load balancing will balance the load according to the variance of load defined by server and control the flow of the traffic and distribution of the traffic with carry distance which will decide the load per distance on server services.
5. Scenario will show the improvement after implementation of proposed scheme by providing the improved results which further will be compared with previous scenario (congestion scenario) for validation. Finally this research will show the improvement done by proposed scheme in graphs with respect to parameters like throughput, delay, retransmission attempt, and network load.

4. Simulation Setup

The above mentioned routing protocols are analyzed through simulation using the popular simulation technique called Network Simulators. NS2 is used for carrying out simulation process. It is based on object oriented and discrete event driven simulation of network which was conventionally developed at university of California-Berkeley. The two programming languages used are C++ and OTcL. The promising feature of simulator is event scheduler. In NS2, to evaluate the simulation time the event scheduler is used. Data path implementation is separated by NS2 from the control path implementation. The event scheduler uses C++ and the basic network component objects are written and compiled in the data path to reduce packet information and processing time of event. OTcl contains those features that C++ lacks.

4.1 Simulation Parameters

Table 1: Parameters used for the experimentation

Parameters	Value
Simulator	NS2
Simulation	30 sec
No of Subnets	5 Logical
No of Nodes	17
Traffic Model	CBR
Pause Time	100 sec
Speed	64 mps
Number of	30
Sub-packet size	256 bytes
Transmit	15mW
Receiving	13 mW
MAC layer	802.11s
Time Slots	Grid

Various parameters used for experimentation is shown in above table 1. The detailed experimentation has been considered in the network simulator 2 with optimized header processing as active generator of traffic and measurement of performance of overall network is judged.

4.2 Performance metrics

We have started with analysis under Network Simulator 2. We started with deployment of multi-relay in the field and channel assignment is assigned to the nodes. Interfaces on the nodes are equal in the initial assignment which is fixed manually by admin. The simulation randomly generates 17 nodes in the range of 1000m×1000m plane. The coordinate of the Sender and receiver is decided. Scenario considered for experimentation is shown below in figure 7.

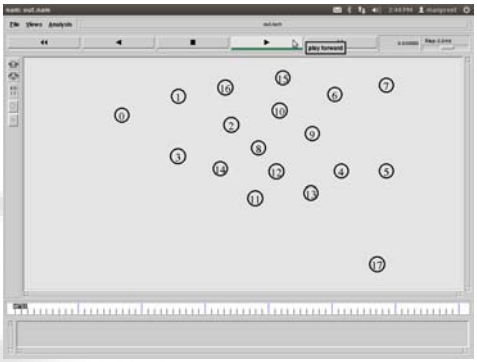


Figure 7: Simulation scenario for experimentation

Now in multi relay network, there is a threshold value for the counter in the whole network. Threshold value is calculated after selecting change in the network performance. We have generated data rate which is fixed to 64 Mbps. With this configuration, transmission range without frame error is approximately 50m and the average number of neighboring nodes is 17, which shows a moderate density. The gateway node is configured as the root of the proactive tree path and the farthest node from the root is maximum 5 hops.Various analyses is obtained by comparing parameters like Packet Delivery Ratio and TCP Throughput, latency and Drop.

A proposed concept of load balancing protocol communication is used to provide seamless communication in wireless network by optimized load balancing scheme to solve the issues created by overhead. In figure 8, concept of the intermediate relay structure for communication in wireless network is shown.

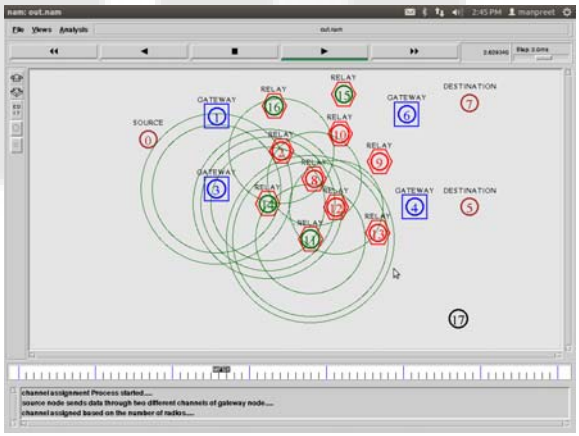


Figure 8: Communication scenario for proposed scheme

The results are based on the simulation of hybrid concept in MIMC for wireless mesh network for controlling overhead and increasing TCP throughput. Results are judged on the bases of TCP Throughput, Packet Delivery ratio, Overhead and Latency. The rsults obtained from proposed work is discussed below.

PACKET DELIVERY RATIO-Packet Delivery Ratio is always used to decide the performance of the network and its processes so we have considered the experimentation with packet delivery ratio with our proposed scheme. Figure 9, showing the packet delivery ratio analysis for proposed work.

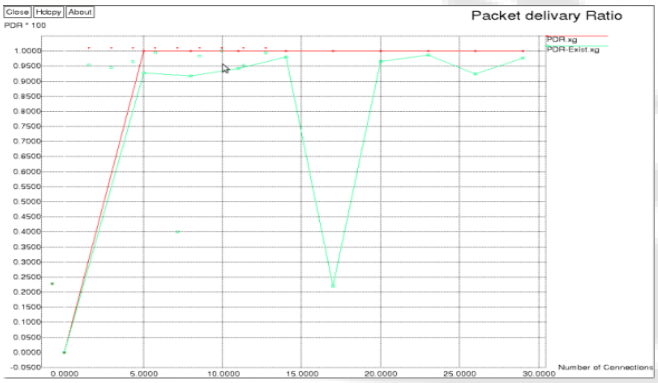


Figure 9: Comparison of optimized load balancing and existing scheme in term of Packet Delivery Ratio

In proposed scenario, the complete simulation is first performed with variation of nodes at a distance of 1000 m with variation of connections.

TCP THROUGHPUT- Throughput of network is very essential when we carried different processes in judging the behavior and productivity of the network. Figure 10, showing the TCP based throughput analysis for proposed work. Comparison for the proposed work is done with existing MIMC based mechanism in wireless mesh network is shown. The comparison shows that TCP throughput of proposed solution is more than the already existing MIMC processes.

TCP throughput based on MIMIC is tested and also treated under proposed work with variation of connections.

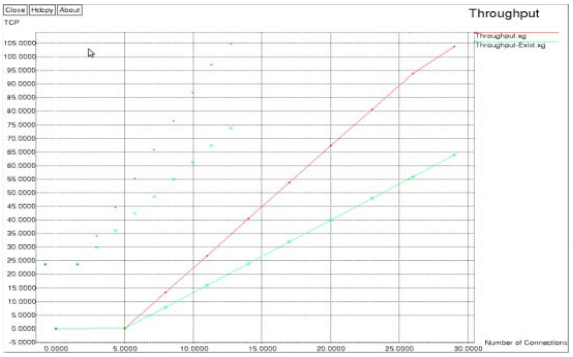


Figure 10: Comparison of optimized MIMC and existing scheme in term of TCP throughput

Throughput shown in proposed work is higher than shown in previous techniques [3] due to less overhead in network.

So this is clear from figure 10, that TCP throughput for proposed work is much higher as compared to already existing MIMIC protocol [3]. There is 35% improvement in throughput in proposed work as compared to MIMC protocol.

LATENCY- In this research, we have considered controlled latency process by managing the time span between updates for load balancing and finding alternative route for balancing. This process controls the overall latency of the network

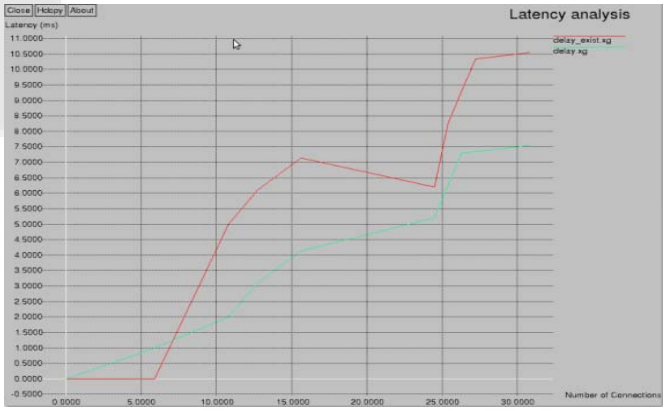


Figure 11: Comparison of optimized load balancing and existing scheme in term of Latency

Latency shown in proposed work is very less than shown in previous techniques due to time management in alternative route selection concept in wireless network.

5 Existing protocols for load balancing and their comparison

PARAMETERS	DLAR	LARA	D-LOAR	LBAR	WLAR	SLAR
Route selection criteria	No. of packets in interface	Traffic density	Cost of path delay and hop count	Degree of nodal activity	Total traffic load	Forwarding load
Routing path	Single path	Single path	Multipath	Single path	Multi path	Single path
Category	Traffic size	Traffic size	Delay based	Traffic size	Delay based	Traffic size
Traditional protocol used	DSR	DSR	ADOV	DSR	ADOV	ADOV + DSR
Neighboring load considerations	No	Yes	No	Yes	No	No
Load balancing decisions	Destination based	Destination based	Intermediate-node-based	Destination based	Destination based	Destination based

Interface queue	No	Yes	Yes	No	Yes	No
Advantages	Routes are reconstructed dynamically in advance of congestion	Uniformly distributes the load among all the nodes in the network, leading to better overall performance	Increases packet delivery fraction and decreases end-to-end delay in a moderate network scenario in comparison to ADOV and other LOAR protocols	Mainly indented for connectionless applications	Avoid influencing of burst traffic	Reduces message overhead

6. Results

The proposed scheme provided 8% more TCP throughput, 12% more packet delivery, 6% less delay when compared to already existing techniques. This research is very useful in providing seamless communication in wireless sensor networks. The solution for sensor communication without increasing overhead and latency with successful load balancing has been solved by proposed work.

7. Conclusion and Future scope

Our research is based on the concept of providing better solution for overhead reduction in wireless network by providing load balancing scheme. Performance of the wireless network communication has been analyzed. In our experimentation we have increased the load balancing options then current environment. To make path failure reorganization easy, we have also added log information to monitor the path failure.The simulation scenario shows the impact of increasing the number of congestion on the optimized performance. Proposed scheme shows the throughput with the various numbers of sensor interfaces. When the number of interfaces increases with reference to number of connections from 2 to 30, the aggregate throughput of the propose scheme is increased around 8 % more as compared to normal sensor communication. However, the aggregate PDR slightly lower than expectations when the number of sensor interfaces is 6.

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