



QOS Enhancement in Data Dissemination Protocols for Wireless Sensor Networks

Shallu Singla

CSE & Kurukshetra University

shallusingla91@gmail.com

Abstract—

A WSN is a specialized wireless network made up of a large number of sensors and at least one base station. Due to many constraints of nodes in wireless sensor networks, a variety of the data dissemination protocols have been developed for data gathering in wireless sensor networks. Sensors extract the useful information from the environment, this information has to be routed through the several intermediate nodes to reach the destination. The main issue in wireless sensor network is energy saving, because the battery power is limited. So the aim of current paper is to evaluate the data dissemination protocols with varying transmission range of a node over wireless sensor network. The IEEE 802.11 standard which especially designed for the wireless network uses default transmission range of 250m. After doing the literature review, we have found that the communication distance of sensor's node can be modifiable and have great impact on the Quality of Service of the sensor networks. In this paper, we try to Enhance the Quality of Service of WSN by vary sensor's node communication distance between 90 to 250 m. We find the best suitable transmission range in which energy of sensor network and other considered performance factor had better results.

Keywords— Wireless sensor networks (WSNs); Quality of service (QOS); Directed diffusion (DD); Omniscient Multicast(OM); NS-2(network simulator-2).

I INTRODUCTION

A WSN is a specialized wireless network made up of a large number of the sensors and at least the one base station. The wireless Sensor Networks (WSNs) as a new information-gathering paradigm, in which a large number of the sensor nodes scatter over a surveillance field and extract the data of interests by reading real-world phenomena from the physical environment. Now a days sensors are very essential for today life to monitor environment where human cannot get involved. A sensor network is composed

of a large number of sensor nodes, which are densely deployed in the environment. The position of these sensor nodes need not be engineered or pre-determined. This allows the random deployment in inaccessible terrains or disaster relief operations. The sensor network protocols and algorithms must possess self organizing capabilities. The feature of sensor networks is the cooperative effort of the sensor nodes. Rather than sending the raw data to the nodes responsible for the fusion, sensor nodes use their processing abilities to locally carry out simple computations and transmit only the required and partially processed data.

In WSN there are two types of nodes: source node – the node which actually sense and collect data – and sink node – the node to which the collected data is sent. The sinks can be part of the network or outside the wireless sensor networks. Usually, there is the more number of source nodes than sink nodes. In most of the WSN applications the sink node does not concern itself with the identification of the source nodes but only about the collected data except in situations where it is required to authenticate the sources. A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions such a sound, temperature, pressure and humidity, vibration. The WSN as shown in Figure 1.1 is built of nodes, each sensor network nodes has a microcontroller, battery and a radio transceiver.

A sensor node might vary in size and correspondingly its cost. Size and the cost constraints on the sensor nodes result in corresponding constraints on resources such as memory, energy, the computational speed and communications bandwidth. The topology of these WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. Propagation technique between the hops of the network can be routing or flooding. The Applications of WSN lie in the area of air pollution, greenhouse, area monitoring, machine health monitoring, water/wastewater monitoring, agriculture, and structural monitoring

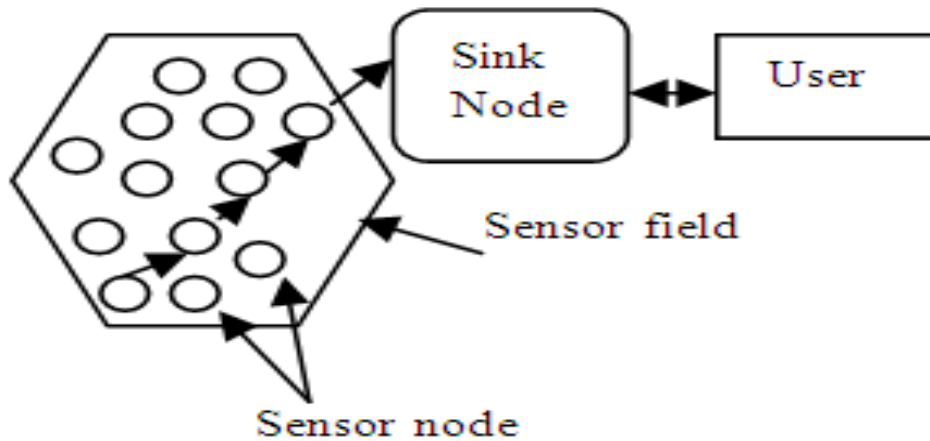


Figure 1.1 Basic Structure of WSN

The main characteristics of a WSN include power consumption constrains for nodes, node failures, mobility of the nodes, communication failures, heterogeneity of the nodes, and ability to withstand harsh environmental conditions and ease of use. The Sensor nodes can be imagined as small computers. They usually consist of a processing unit with limited computational power and limited memory, a communication device and a power source. Due to many constraints of the nodes in wireless sensor networks, a variety of the data dissemination protocols have been developed for data gathering in wireless sensor networks. Sensors extract the useful information from the environment; this information has to be routed through several intermediate nodes to reach the destination.

II THE OVERVIEW OF DATA

DISSEMINATION ROUTING PROTOCOLS

Data dissemination is the process by which queries or data are routed in the sensor networks. Data dissemination has many problems including; data propagation, energy balance, power savings. Proposed solutions for these problems are the application-specific paradigms, which facilitate efficient delivery of sensed data to inquiring destination. The Data Dissemination Protocols deals with mainly three protocols i.e. direct diffusion, flooding and omniscient multicast.

2.1 Directed Diffusion

Directed diffusion is a data-centric communication paradigm where a sink (node requesting a service) sends out a request for data by broadcasting an interest to its neighboring nodes. Figure 2.1 shows the operation of data centric communication

protocol for a WSN scenarios. Directed diffusion protocol based on query, where sink queries the sensors in an on-demand fashion by disseminating an interest. Directed diffusion consists of three stages: the interest propagation, initial gradient setup and the data delivery along reinforced path.

2.1.1 Interest Propagation

Sink node send out its query whenever it wants to obtain some information from sensor nodes. This query is carried by interest packet. The node which has received the interest packet can cache the packet temporarily and search for all of the matching target data as shown in figure 2.1(a).

2.1.2 Initial Gradient Setup

Using Gradient in directed diffusion, the data propagation direction with minimum cost principle. Propagation of interest packets setup the gradient in the network for delivering data to the sink. Gradient is a reply link to a neighbour from which the interest was received as shown in figure 2.1(b).

2.1.3 Data Delivery Reinforced Path

Data propagation, source node sends data packets to sink node the initial setup gradient direction. Sink sends a reinforced packet to the neighbour node which is the first one receiving the target data. The neighbour node which receives the reinforced packet can also reinforce and select the neighbour node which can receive the new data first. Consequently, a path with maximum gradient is formed, so that in future received data packets can transmitted along best reinforced path. Finally the real data will send from the source, in selected path as shown in figure 2.1(c).

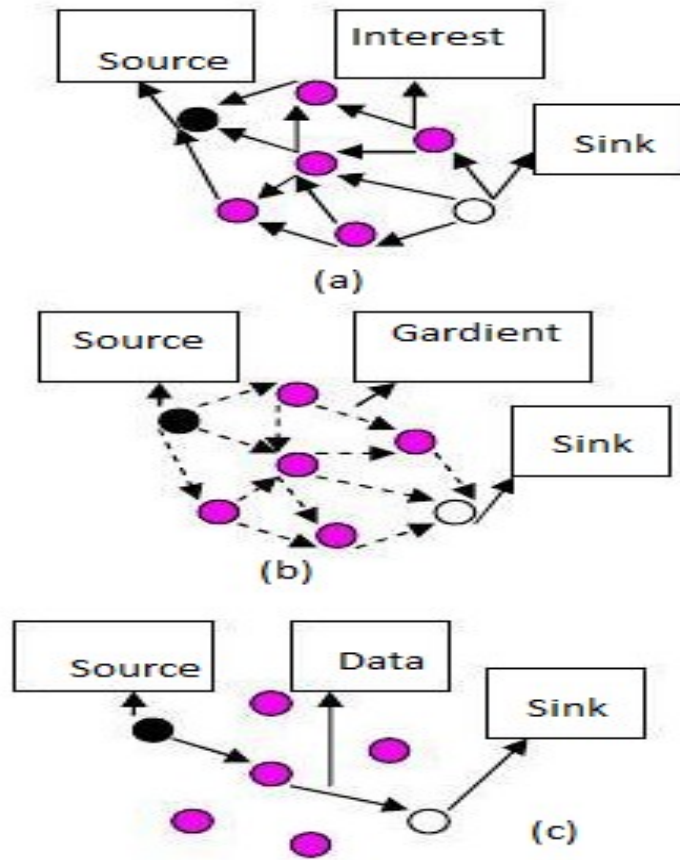


Fig.2.1 Directed Diffusion (a) Interest propagation (b) Initial gradient setup (c) Data delivery reinforced path

2.2 Flooding

In the flooding scheme, sources flood all events to every node in the network. Flooding is a contrary case for directed diffusion, if the latter does not perform better than flooding does, it cannot be considered viable for sensor networks. Fig 2.2 shows the flooding network.

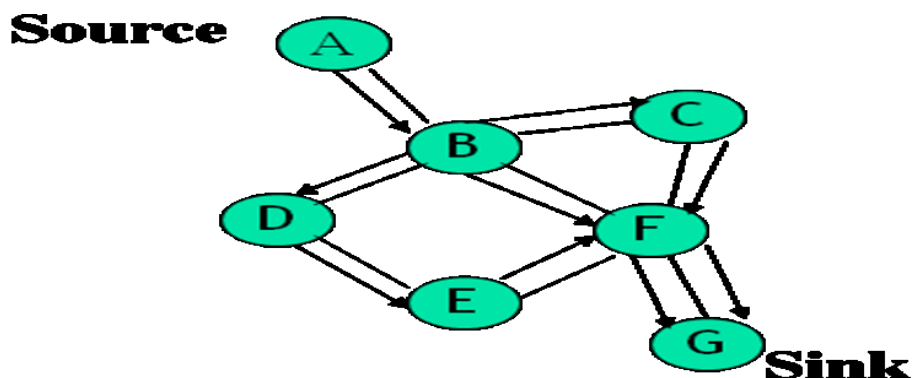


Fig 2.2 Flooding network

2.3 Omniscient Multicast

In the omniscient multicast scheme, each source node transmits its events along a shortest path multicast tree to all sink nodes. The analysis of the omniscient multicast routing protocol, as well as do not account for the cost of tree construction protocols. Rather than centrally compute the distribution trees and do not assign energy costs to this computation. Omniscient multicast instead indicates the best possible performance achievable in an IP-based sensor network without considering

overhead. Omniscient multicast offers the advantage that it is not dependent on fixed multicast trees, as could be defined in fixed, wired topologies, but routes packets based on definition of the information sinks. At each node, when the router layer receives a packet, it decides whether to pass the packet up the stack based on the sink table it maintains. Omniscient multicast is unrealistic in that it assumes all route information is available at no cost. Fig 2.3 shows the omniscient multicast network

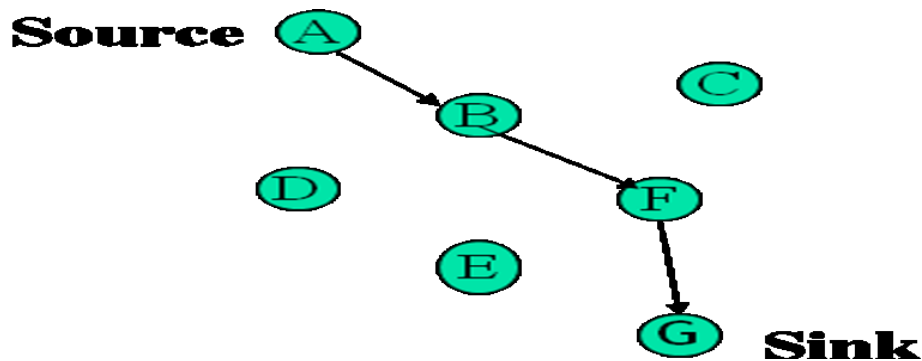


Fig 2.3 Omniscient Multicast

III RELATED WORK

Many of the researchers evaluate the performance of Data Dissemination routing protocol using different evaluation methods means on the basis of different performance metric or using different simulators for this purpose. At present, there are several papers related to performance evaluation of Directed Diffusion(DD), Flooding and Omniscient Multicast (OM). We have observed that, though there is a significant difference between Data Dissemination protocol in WSN[1,3,15] but by varying a transmission range in between them is not yet analyzed and obtain high energy. So we have focused on the performance of the protocol by changing a communication range and compute the performance metrics such as remaining energy, average end to end delay, and routing overhead [1,2,3,15]. In Ref. [1], I.F.Akyildiz et al. Presents recent advancements in wireless communications and electronics, which have enabled the development of low-cost sensor, networks. The sensor networks can be used for various application areas (e.g., health, military, home). For different application areas, there are different technical issues that researches are currently resolving. The current state of the art of sensor networks is discussed in this a survey on sensor networks. A.Bharathidasan et al. [4] have presented various issues in sensor networks like energy efficiency,

routing and localization. Various schemes proposed have been described. Also proposed future work in the areas of media access control, security and privacy. In Ref. [6], C.Intanagonwiwat et al. explore directed-diffusion paradigm for designing distributed sensing algorithms. Many topics for preliminary evaluation of diffusion. First, directed diffusion has the potential for significant energy efficiency. In Ref. [15], Ad-hoc network is an infrastructureless network which consists of a set of nodes, communicate over a transmission radio. It does not require any central administration. In this paper, we evaluate some of the widely used efficient routing protocols with varying transmission range of the node. Data transmitted by a node is received by all the nodes within its communication range. We focus on the analysis of varying a range of the transmission in terms of distance. In this paper, we observed and analyzed our experiment with the varying transmission range for Data Dissemination protocols in wireless sensor networks. In the WSN, intermittent flooding of routing information is quite expensive, since all nodes compete for access to the wireless medium with limited bandwidth. Special routing protocols are needed for wireless sensor networks. We have taken three routing protocols such as DD, flooding and OM for the analysis of transmission range.



IV SIMULATION SETUP AND PERFORMANCE METRIC

4.1 Simulation Tool & Parameters:-

We have used Ns-2 for the simulation of protocols. Each data dissemination protocol has used the same IEEE 802.11 MAC protocol. The same topology scenarios are used across different protocol simulations. To deal with the problems stated above, the author changes the value of transmission range for the Data dissemination protocol (Direct Diffusion, Flooding, and Omniscent) and enhances the quality of WSN. The number of Nodes in WSN remains same in our work and varies the transmission range of the sensor node. To achieve

this task author uses NS2 tool for simulation Using Linux 5.

4.1.1 Tool used

Author use a tool NS2 Network Simulator (Version 2.29), widely known as NS 2.29, is simply an event-driven simulation tool that has proved useful in studying the dynamic nature of communication networks. Simulation of wired as well as wireless network functions and protocols (e.g. Data dissemination protocol (Direct Diffusion, Flooding, and Omniscent)) can be done using NS2. In general, NS2 provides users with a way of specifying such network protocols and simulating their corresponding behaviors.

4.1.2 Simulation Parameters

To take accurate results from the simulations, we used Data Dissemination protocols. Here we can use the transmission range 90,120,150, 180,210,250. with number of nodes are 50. Used parameters shown in table 4.1 as below:

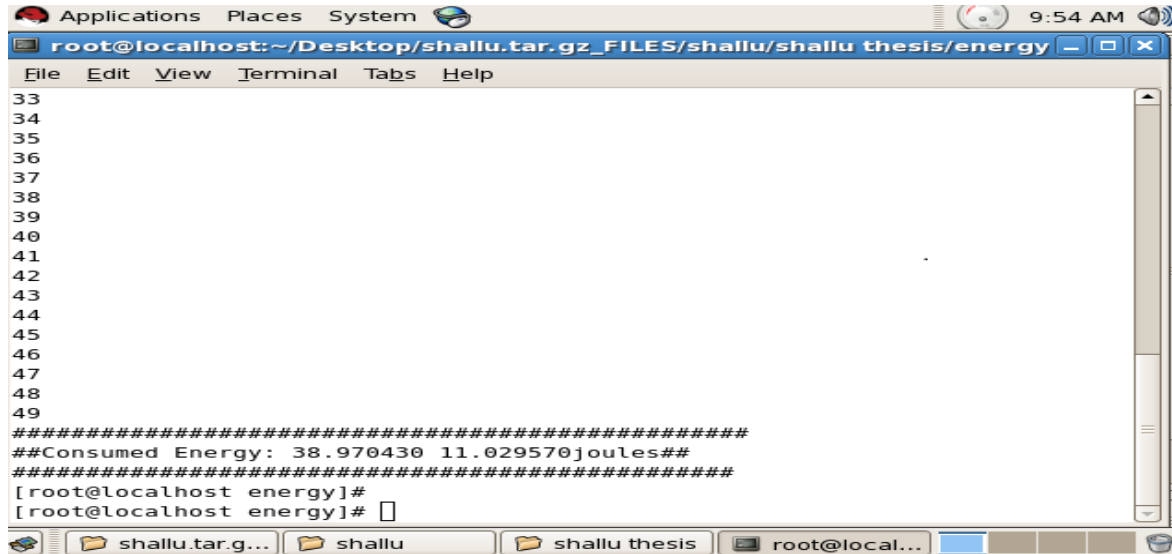
Parameter	Value
Network Simulator	NS-allinone-2.29
Channel type	Wireless channel
Radio-propagation model	Two Ray Ground
Antenna type	Omni Antenna
Interface queue type	Drop Tail/Pri Queue
Routing protocols	DD/Flooding/Omniscient Multicast
MAC type	802_11
Transmission range	90,120,150,180,210,250
No. of nodes	50
Network Dimension	600*600m
Simulation Time	100s
Size of data packet	64 bytes
Node Intial Energy	50 joule

Table 4.1 Simulation Parameter

4.2. Performance Metrics

In this work, following performance metrics will be used to evaluate and analyze the performance of three data dissemination protocols.. These different metrics are calculated with respect to transmission range. These metrics are defined as follows:

4.2.1 Remaining Energy: Remaining energy of a network is defined as the difference of total energy of a network and energy consumed by a network. **Remaining Energy = total energy of a network – energy consumed by a network.** The remaining energy value for flooding protocol at transmission range 120 as shown in figure 4.1



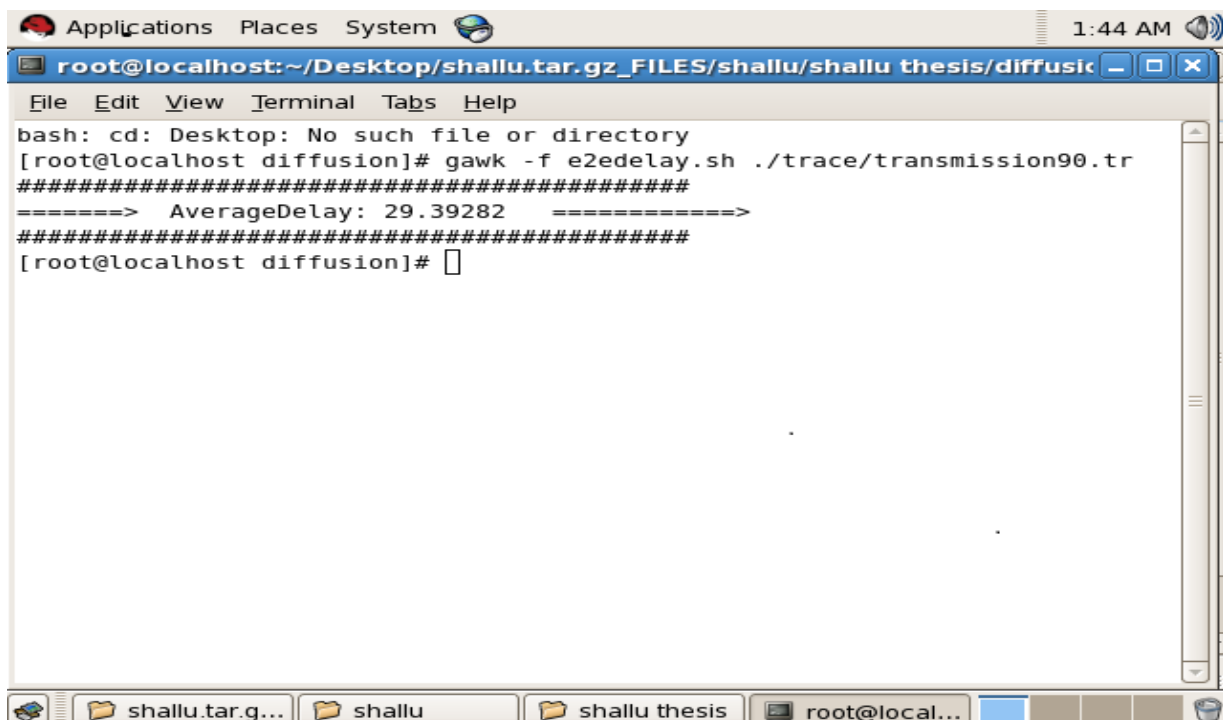
```

Applications  Places  System  9:54 AM
root@localhost:~/Desktop/shallu.tar.gz_FILES/shallu/shallu thesis/energy
File Edit View Terminal Tabs Help
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
#####
##Consumed Energy: 38.970430 11.029570joules##
#####
[root@localhost energy]#
[root@localhost energy]#

```

Figure 4.1: Flooding Energy values at transmission range120

4.2.1 Average delay: Average delay measures the average one-way latency observed between transmitting delay of an event and receiving it at the each sink. That metric defines the temporal accuracy of the location estimates delivered by the sensor network. Average Delay for DD at transmission range 90 as shown in figure 4.2:



```

Applications  Places  System  1:44 AM
root@localhost:~/Desktop/shallu.tar.gz_FILES/shallu/shallu thesis/diffusic
File Edit View Terminal Tabs Help
bash: cd: Desktop: No such file or directory
[root@localhost diffusion]# gawk -f e2edelay.sh ./trace/transmission90.tr
#####
=====> AverageDelay: 29.39282 <====
#####
[root@localhost diffusion]#

```

Figure4.2: Show DD average delay at transmission range 90

4.2.3 Routing Overhead: Routing overhead is defined as the total no of routing packets to the total number of received data packets at the destination. **Routing overhead = the total number of routing packets at destination / total number of received data packets at destination.** The Routing Load in Direct Diffusion at transmission range value is 210 as shown in figure 4.3:

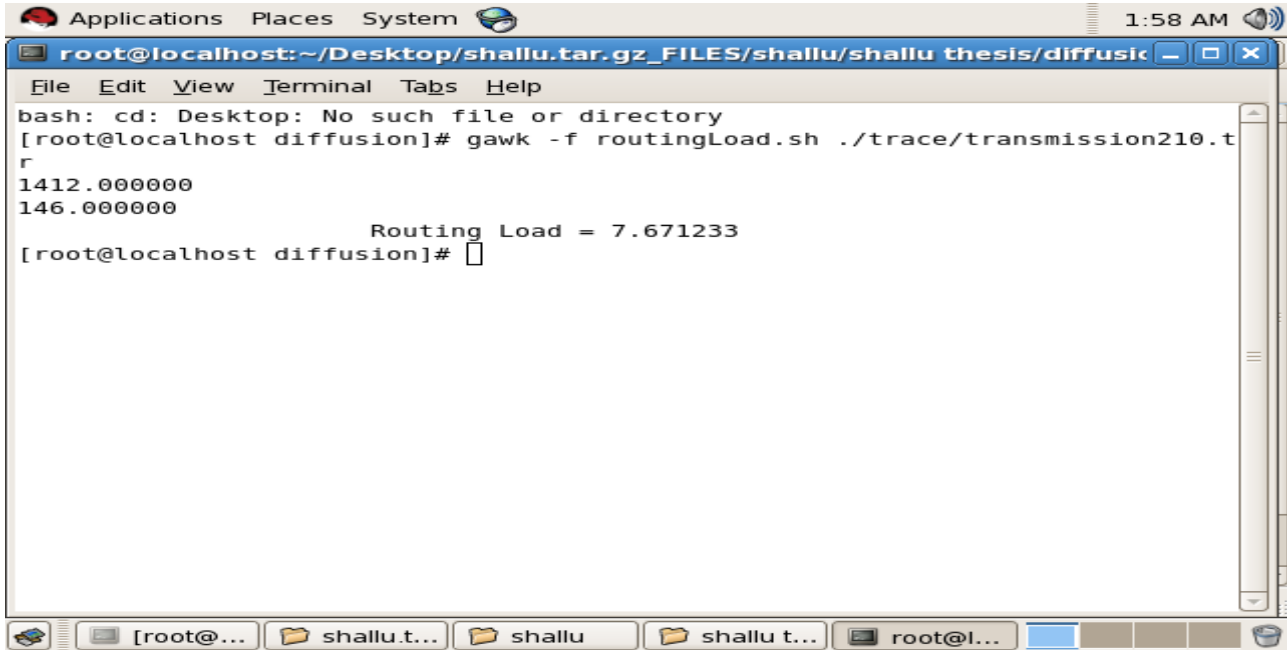


Figure4.3: Show DD routing load at transmission range 210

V SIMULATION RESULTS

The performance of DD ,OM and flooding has been analyzed with varying transmission range with a distance of 90m,120m, 150m,180m,210m and 250m of simulation time 100s using ns2 . We compute the performance of Data Dissemination protocols with selected metrics such as remaining energy, average delay and routing overhead for a various range .Figure 5.1 show simulation of 50 sensor nodes for DD protocol at transmission range 210. NS2 (Version 2.29) tool is used for the simulation which can be installed on Linux platform. Using VM ware, Linux can be used on windows platform which the author is using in the dissertation. Below Graph showing simulation for 50 nodes in routing protocols.

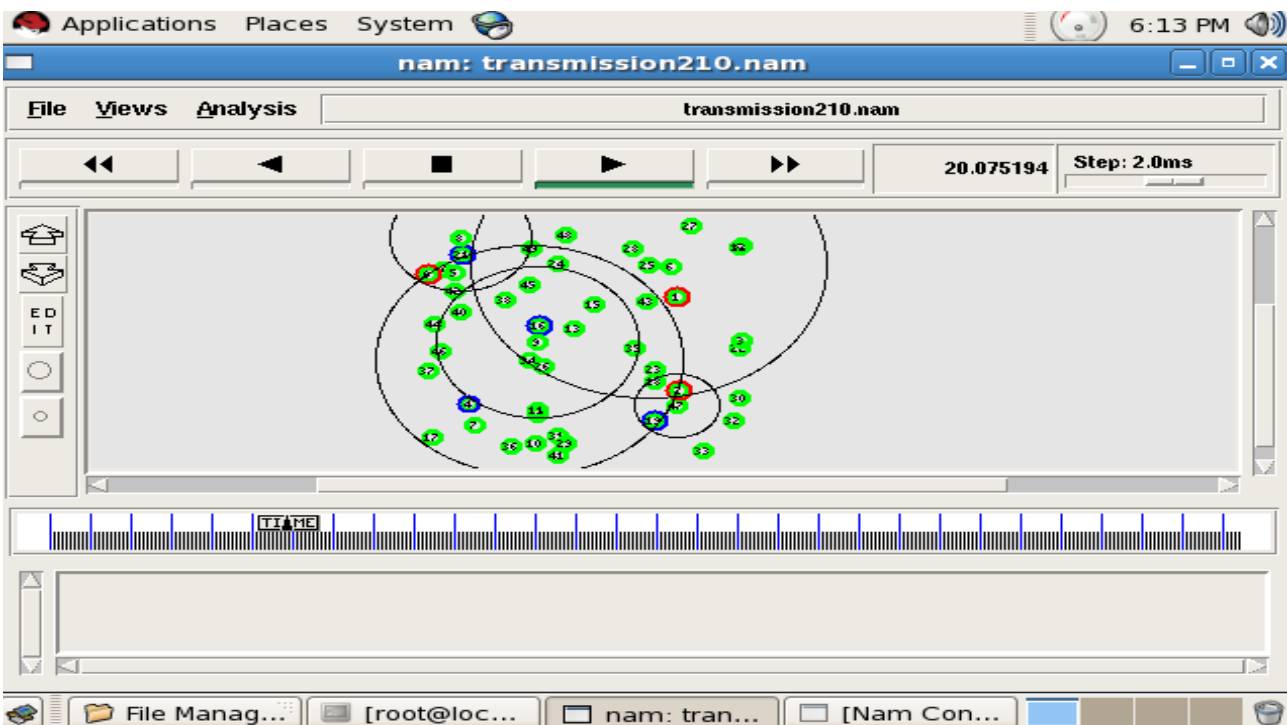


Figure 5.1: Nam Animator DD with transmission range 210

Table 5.1 Show the values of Routing Protocols DD in this table. we take the simulation time value 100s at particular delay, energy and routing overhead for different routing protocols:

Transmission Range	Remaining Energy			Routing Overhead			Average Delay		
	DD	Omnicient	Flooding	DD	Omnicient	flooding	DD	Omnicient	Flooding
90	14.97	11.55	10.81	15.07	9.05	15.95	29.39	0.93	0.23
120	13.034	11.01	11.02	10.11	7.3	15.92	17.156	0.69	0.19
150	14.98	11.18	10.87	8.91	7.9	15.94	48.67	0.56	0.18
180	14.99	11.12	10.81	7.82	5.2	15.94	24.02	0.32	0.16
210	14.99	11.35	10.84	7.67	4.25	15.95	18.85	0.22	0.16
250	10.97	11.14	10.83	6.63	4.06	15.95	3.7	0.14	0.16

Table 5.1: Showing Values of remaining energy, Routing overhead and average delay

Figure 5.2, 5.3, 5.4 show the values of Remaining Energy, Routing Overhead, Average delay in the graphical form as below:

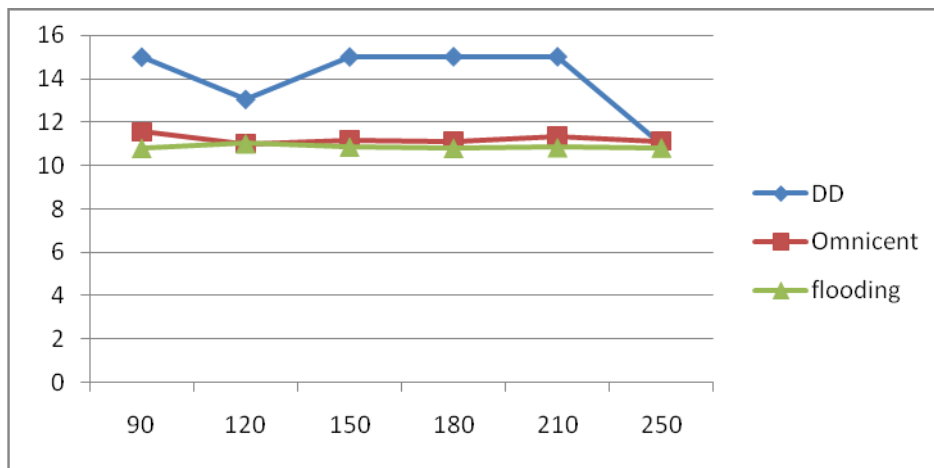


Figure 5.2: Graph for showing Remaining Energy Values

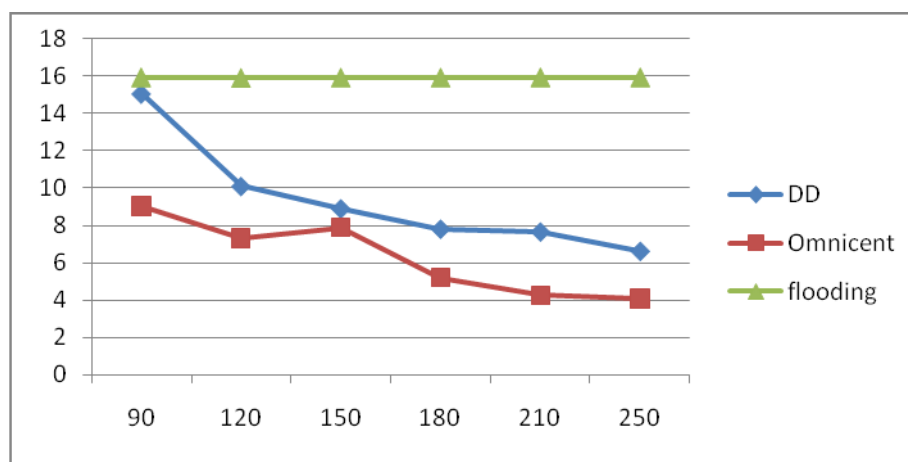


Figure 5.3 Graph for showing Routing Overhead Values

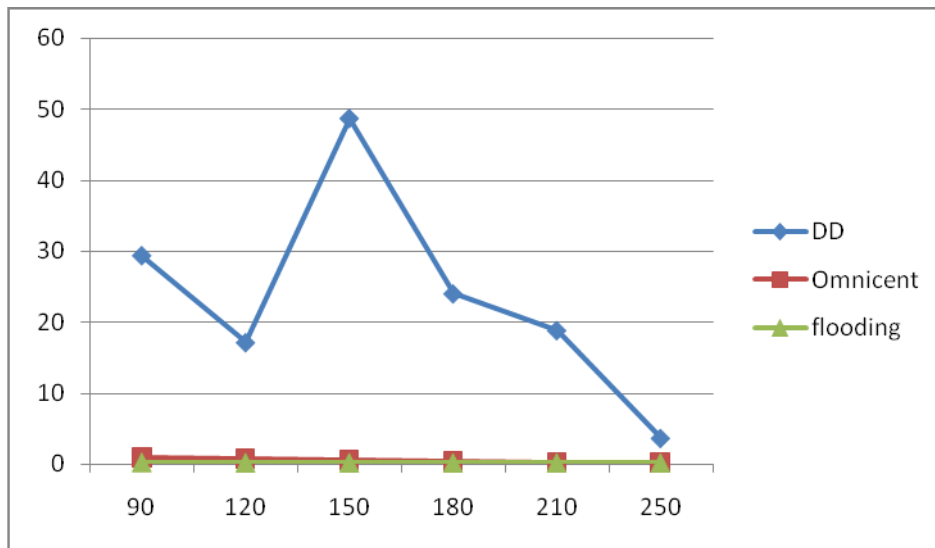


Figure 5.4: for showing Average Delay

Analysis of Results

We have taken total of fifty nodes in our simulation evaluation process as shown in the figure 5.2 to figure 5.4 above. In the above figure it is being observed that in the starting of simulation process one every node is working in cooperation with each other to keep the network in communication. Graph 5.2 to 5.4 shows the values of Remaining Energy, Delay and routing overhead in Data Dissemination protocols. From fig 5.2 it is observed that directed diffusion show high value of remaining energy in the Sensor network as compare to flooding and omniscient multicast. Maximum energy is saved in direct diffusion. From the fig 5.3 it is observed that flooding protocol shows the small change in the values of routing load but in DD and omniscient multicast routing load decreases when we increases the transmission range value. From graph 5.4 it shows that end to end delay is less in DD at the particular value of transmission range and in flooding and omniscient multicast only small changes occurred at different ranges of transmission value. From the graphs we observed that DD saves more energy and less routing overhead and average delay at transmission range 210m. But in flooding protocol maximum energy save and other parameter is average at transmission value 120m. from the above three graph it also shows that omniscient shows their best parameter analysis at transmission range 210 m. The better performance of DD in comparison of these other protocols in the sensor network. DD is more suitable from other two protocols comparatively because DD saves maximum remaining energy of the sensor nodes in WSN and average delay is also less as compare to the other protocols.

VI CONCLUSION

The transmission range as a system parameter affects the overall energy consumption of wireless sensor networks. The performance of these three routing protocols shows some differences by varying transmission range and simulation time. The transmission range varies from 90 to 250m. Data transmitted by a node is received by all the nodes within its communication range. This work will compare directed diffusion protocol with two other data dissemination protocols namely: omniscient multicast and flooding in terms of remaining energy, average delay, routing overhead with respect to transmission range. Direct diffusion saves the maximum energy, less average delay and routing overhead at transmission range 210m. In flooding routing protocol we obtained higher energy, lesser average delay and routing overhead at transmission range 120 m. But in omniscient multicast we save more energy at transmission range 210 m. From our work, we conclude that direct diffusion has maximum remaining energy, less average delay, less routing overhead compared to flooding and omniscient multicast protocol. We compare the three protocols in this research work. We found that overall performance of Direct Diffusion is better than other two protocols. We found the suitable transmission range 210m in which quality of network is best.

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