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Investigation of Different Parameters of Dynamic Source Routing with varied Terrain Areas and Pause Time for Wireless Sensor Network

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ABSTRACT

Wireless Sensor Networks (WSNs) are group of small sensor nodes and wireless communication capabilities. WSNs often use many routing protocols, power management protocols and data dissemination protocols where the design is to energy awareness and how can save energy. [1] Easy deployment, fast communication and low maintenance are main advantage of wireless sensor network. [2]

The functionalities and parameters of individual devices in the wireless sensor network (WSN) are very limited like processing speed, storage capacity, and communication bandwidth. When these devices are integrated, it will have processing capabilities, but not individual. According to the physical phenomena within the network itself we must combine these devices. [3]

Wireless Sensor Networks are the latest trends in the market due to the demand for communication and networking among these wireless network devices have been increased for different applications. [4]

The routing protocols are used in the Wireless Sensor Networks for efficient communication of data between sensor nodes. The designs of routing protocols in Wireless Sensor Networks are very concern because of they are influenced by many challenging factors. These factors must be overcome before efficient communication can be achieved in Wireless Sensor Networks. [2]

The main focus of this paper is to discuss and evaluate the performance of different parameters in different scenarios and different terrain areas which may be small, large and very large in wireless sensor network using Dynamic Source routing protocols and for monitoring of critical conditions with the help of important parameters like Throughput, Packet Delivery Fraction, and End-to-End delay in different scenarios.

Keywords: **Wireless Sensor Network, Packet Delivery Fraction, End-to-End Delay, Network Simulator**

I. INTRODUCTION

Wireless Sensor Networks are designed by many small nodes with sensing and wireless communication capabilities. The Wireless Sensor Networks are categorized in two parts: structured Wireless Sensor Networks and unstructured Wireless Sensor Networks. The structured Wireless Sensor Networks are planned network where the nodes are deployed in the field with the specific planning. The unstructured Wireless Sensor Networks are unplanned network where the nodes are deployed in the field using ad-hoc manner. They have no fixed infrastructure for communication for Wireless Sensor Networks. These networks have many challenges issues of manufacturing, design and management due to the deployment of nodes in large terrain areas. [5]

A Wireless Sensor Networks consists of a network that is made of hundreds or thousands of sensor nodes which are deployed in an unstructured environment with the sensing capabilities, computation and wireless communication (i.e. collecting and disseminating environment data). [6]

As show in figure1, the basic architecture of wireless sensor network consists of large amount of sensor nodes which have the ability to communicate data either among each-other or directly to an external base station (BS). A large amount of sensor nodes increase sensing accuracy over large terrain areas.
The study of wireless sensor network is done by performing simulation that can help in better understanding of behavior of various routing protocols. [4] DSR is the routing protocol in wireless sensor network to evaluate performance parameters like End-To-End delay, Packet Delivery Fraction and Throughput using NS-2. These simulation parameters are helpful to increase accuracy of data communication between nodes in wireless sensor network. This paper describes the performance matrices on different topologies based on varying

the pause time. Here we try to find out the relationship between different parameters and small, large and very large topologies on varying Pause time.

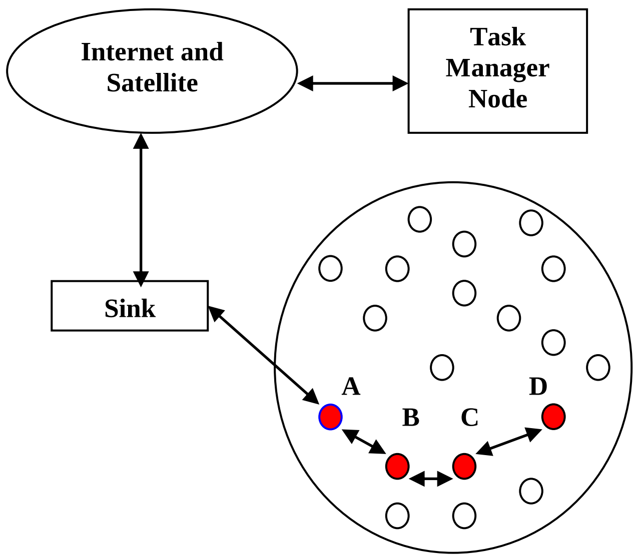

Fig. 1: Basic Architecture of Wireless Sensor Network

In this paper we describe in Section 1 Introduction Section 2 Routing Protocol Section 3 Simulation Tool Section 4 Simulation parameters Section 5 Related Work Section 6 Simulation Setup Section 7 Results and Analysis and section 8 Conclusion

II. ROUTING PROTOCOL

In this section we determine the routing protocols state art for Wireless Sensor Networks. Basically the routing protocols of WSNs are categorized into flat based routing, location based routing, and hierarchical based routing depending on the network structure. [15] In the flat based routing all sensor nodes are equally performed functionalities or assigned equal roles while the hierarchical based routing however all nodes will play different roles in the network. In the location based routing all sensor nodes positions are divided to route data in the network.

The dynamic source routing is a reactive routing protocol which uses source routing to send packets. The source routing means the source which is defined with complete hop sequence to the destination end. A route cache is used by each node in the network to maintain routes for all nodes. DSR uses a route discovery process if the desired route (Data transfer from source to destination node) can not be found in the route cache. [7]

In DSR protocol there are two mechanisms which are working together to allow the discovery and maintenance of source routes in the Wireless Sensor Networks. [7]

(a) Route discovery is the first mechanism used to transfer packet from source node to destination node using source route. It discovers the source route by which a node N want to send a packet to a destination node DN. Route discovery mechanism is attempted only when node N want to send a packet to destination node DN and does not already know route to DN. [8]

(b) The second mechanism of DSR protocol is the route maintenance which maintain the route of source to destination or when the source route is broken to destination node (DN). When the network topology has changed and its route to DN is no longer use due to any reason. Route maintenance warns that a source route is broken and node N can use the other available route. Route maintenance also sends the information to route discovery to find a new route. Route maintenance is used when node N really wants to send packet to destination node (DN). [8]

III. SIMULATION TOOL

Network simulators are very important and efficient analyzing tool used for research. Network simulators are used for analyzing of different protocols used for wired and wireless networks and its necessity is very well known in the field of research. [9]

NS-2 is often used network simulator and this is one of most popular simulator for the researchers. NS-2 is extended to the wireless sensor network and its protocols. NS-2 uses object oriented design for implementation of different modules of a sensor network. [10] These modules may be used for energy model, wireless channel and sensor channel which provide dynamic inter-action between sensor nodes and dynamic environment.

NS-2 uses TCL (Tool Command Language) to write a front-end of the program. NS-2 simulator uses C++ as back-end of the program. When a TCL program is compiled a trace files, nam files are created. These files indicates movement pattern of the nodes and it keeps the number of hops between 2 nodes, number of packets send and connection type etc at each instance. The connection pattern file (CBR file) and speed of communication are used to define the connect pattern, topology and packet type. These files are also used to create the trace file and nam file which are further used to simulate the network. [11]

IV. SIMULATION PARAMETERS

In order to evaluate the performance of wireless network routing protocols, the following parameters were considered:

(I) Packet Delivery Fraction (PDF): Packet Delivery Fraction is the ratio of the number of data packets successfully delivered to the destination nodes and number of data packets produced by source nodes. [12]

(II) End-to-End Delay: The term End-to-End delay refers to the time taken by a packet to be transmitted across a network from source node to destination node which includes retransmission delays at the MAC, transfer and propagation times and all possible delays at route discovery and route maintenance. [5] The queuing time can be caused by the network congestion or unavailability of valid routes. [13]

(III) Throughput: The term throughput refers the number of packet arriving at the sink per ms. Throughput is also refers to the amount of data transfer from source mode to destination in a specified amount of time. The goal is to calculate maximum throughput of IEEE 802.11 technologies in the MAC layer for different parameters such as packet size. [13]

V. RESEARCH WORK

There are many research papers on routing protocols in wireless sensor network and all are used for evaluating performance of different parameters in different scenario. Researchers specify the difference between routing protocols and its performance for different parameters and which one is best for the case of Wireless Sensor Network.

In comparison of AODV, DSDV and DSR the Average end-to-end delay and throughput in DSR are very high. While in comparison of DSDV and AODV routing protocols, AODV performed better than DSDV in terms of bandwidth as AODV do not contain routing tables so it has less overhead and consume less bandwidth while DSDV consumes more bandwidth. [14] In this paper we selected to investigated DSR protocol for different performance parameters for different Terrain areas like small (1 Km. x 1 Km.), large (2 Km. x 1 Km.) and very large (2 Km. x 2 Km.)). Analysis were done using ns-2 simulator on these three cases of terrain areas in order to derive an estimation of the performance parameters.

VI. SIMULATION SETUP

In this paper, we tested and investigated DSR protocol with a scenario where a total of 100 nodes are used with the maximum connection number 10; and a hop that have 10 CBR; transfer rate is taken as 4 packets per second and the pause time is varied starting from 0 sec., 20 sec., 40 sec., 60 sec., 80 sec., and 100 sec. (i.e. in the steps of 20 sec.) implemented respectively in a 1 Km. x 1 Km., 2 Km. x 1 Km. and 2 Km. x 2 Km. terrain areas. The simulation time was taken to be of 100 seconds. The details of general simulation parameter are depicted in Table 1

TABLE 1
Simulation Parameter Values

S. No.	Parameters	Values
1	Transmitter range	250m
2	Bandwidth	2 Mbps
3	Simulation time	100 sec
4	Number of nodes	100
5	Max Speed	10
6	Pause time	0, 20, 40, 60, 80, 100 sec
7	Terrain Area	1 Km. x 1 Km., 2 Km. x 1 Km., 2 Km. x 2 Km.
8	Traffic type	Constant Bit Rate
9	Packet size	512 bytes data
10	MAC type	IEEE 802.11b
11	Antenna type	Omni-Antenna
12	Radio propagation method	Two Ray Ground

VII. RESULT AND ANALYSIS

The investigations were performed on Parameters such as Packet Delivery Fraction, Average End-to-End Delay, and Average Throughput. The experimental data are shown in Tables 2, 3 and 4 respectively and their respective performance being shown in Figure 2, 3 and 4 respectively.

(A) When Nodes-100, Pause Time - 0-100secs, Maximum Speed- 10m/s, Routing protocol- DSR, and Evaluating Parameter- Packet Delivery Fraction.

TABLE 2
Evaluating Parameters: Packet Delivery Fraction

Pause Time→ Topology ↓	0	20	40	60	80	100
1 Km. x 1 Km.	97.42	97.61	99.42	99.73	99.82	99.82
2 Km. x 1 Km.	83.24	96.35	70.2	93.08	99.09	99.96
2 Km. x 2 Km.	76.81	70.97	43.08	55.28	37.69	80.86

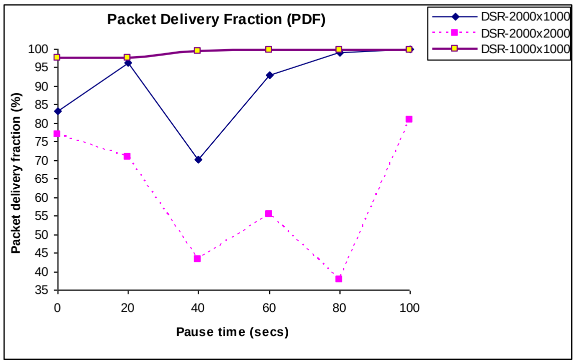

Fig 2: Pause time versus packet delivery fraction when terrain areas are 1 Km. x 1 Km., 2 Km. x 1 Km., 2 Km. x 2 Km.

Using the DSR routing Protocol with 100 nodes, maximum Speed 10.00m/s, varying pause time (0-100sec by interval of 20sec) and 1 Km. x 1 Km., 2 Km. x 1 Km. and 2 Km. x 2 Km. terrain areas, we examine that Packet Delivery Fraction in 1 Km. 1 Km. is more optimal than 2 Km. x 1 Km. and 2 Km. x 2 Km. So if we implement wireless sensors in biggest terrain areas, the packet delivery fraction is decreased on varying pause time. We can derive a formula according to simulation results as:

Packet Delivery Fraction α 1/Terrain Areas

(B) When Nodes-100, Pause Time - 0-100secs, Maximum Speed- 10m/s, Routing protocol- DSR, and Evaluating Parameter: Average End- to-End Delay

TABLE 3
Evaluating Parameters: Average End-to-End Delay

Pause Time→ Topology ↓	0	20	40	60	80	100
1 Km. x 1 Km.	77.0 8	69.5 7	45.25	21.33	40.5 1	33.2 4
2 Km. x 1 Km.	897. 34	168. 64	2171. 12	404.8 6	53.4 4	32.4 5
2 Km. x 2 Km.	1168 .88	2434 .04	2317. 69	2676. 68	929. 30	60.8 5

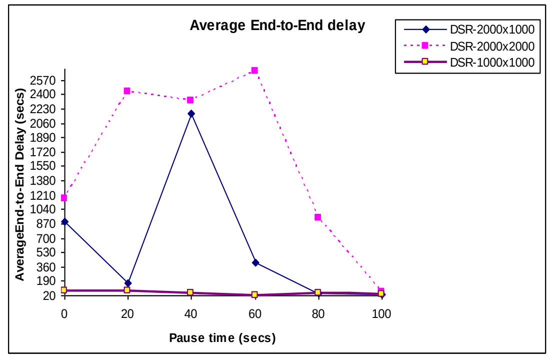

Fig 3: Pause time versus Average End- to-End Delay when terrain areas is 1 Km. x 1 Km., 2 Km. x 1 Km., 2 Km. x 2 Km.

Using the DSR routing Protocol with 100 nodes, maximum Speed 10.00m/s, varying pause time (0-100sec by interval of 20sec) and 1 Km. x 1 Km., 2 Km. x 1 Km. and 2 Km. x 2 Km. terrain areas, we examine that Average End-to-End Delay in 2 Km. x 2 Km. is more optimal than 1 Km. x 1 Km. and 2 Km. x 1 Km. So if we implement wireless sensors in biggest terrain areas, the Average End-to-End Delay is increased on varying pause time. We can derive a formula according to simulation results as:

Average End- to-End Delay α Terrain Areas

(C) When Nodes-100, Pause Time - 0-100secs, Maximum Speed- 10m\s, Routing protocol- DSR, and Evaluating Parameter: Average Throughput (kbps)

TABLE 4
Evaluating Parameters: Average Throughput (kbps)

Pause Time→ Topology ↓	0	20	40	60	80	100
1 Km. x 1 Km.	90.7 1	91.1 8	93.7 7	93.1 7	93.5 0	94.0 2
2 Km. x 1 Km.	78.1 2	89.9 9	66.2 6	87.6 6	92.0 3	93.6 0
2 Km. x 2 Km.	72.6 9	66.5 7	40.4 4	51.7 4	35.6 5	75.2 9

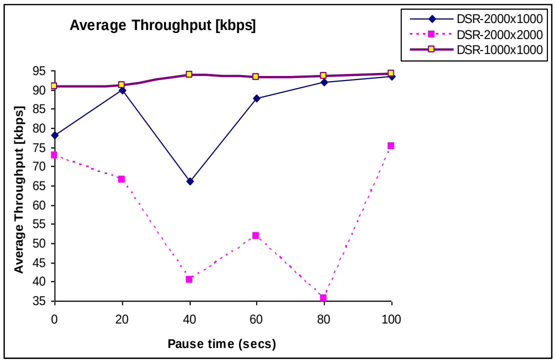

Fig 4: Pause time versus Average Throughput (kbps) when terrain areas are 1 Km. x 1 Km., 2 Km. x 1 Km., 2 Km. x 2 Km.

Using the DSR routing Protocol with 100 nodes, maximum Speed 10.00m/s, varying pause time (0-100sec by interval of 20sec) and 1 Km. x 1 Km., 2 Km. x 1 Km. and 2 Km. x 2 Km. terrain areas, we examine that Average Throughput in 1 Km. x 1 Km. is more optimal than 2 Km. x 1 Km. and 2 Km. x 2 Km. So if we implement wireless sensors in biggest terrain areas, the Average Throughput is decreased on varying pause time. We can derive a formula according to simulation results as:

Average Throughput α 1/Terrain Areas

VIII. CONCLUSION

The results of our simulations are analyzed and discussed in this section. The results are analyzed and discussed in different terrain areas having networks of 100 sensor nodes on varying Pause time (00-100secs with interval of 20secs.) for evaluating performance of different parameters like Packet Delivery Fraction, Average Throughput and Average End-to-end Delay in small, large and very large terrain areas.

Our study provides an optimal result which is fully based on simulation and analysis. Every case explains evaluation of parameter with the help of table and generated graph. Each case represents a special issue for metric and Terrain area (which is small (1 Km. x 1 Km.), large (2 Km. x 1 Km.) and very large (2 Km. x 2 Km.)). According to the analysis value we drive a formula for each case that fully satisfies the values and relationship between parameters and terrain areas which is small (1 Km. x 1 Km.), large (2 Km. x 1 Km.) and very large (2 Km. x 2 Km.). The overall results says that when we implement sensor nodes in small terrain areas give better performance rather than Large and very large terrain areas.

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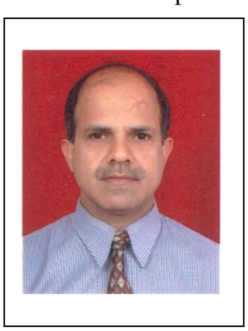

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