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Performance evaluation of parameters Using DSR Routing Protocol in WSNs

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Abstract— ***Wireless Sensor Networks (WSNs) are group of small sensor nodes and wireless communication capabilities. The functionalities and parameters of personality strategy in the wireless sensor network (WSN) are very incomplete like processing speed, storage capacity, and communication bandwidth. When these devices are included, it will have processing capabilities, but not individual. The individual devices in a wireless sensor network (WSN) are inherently resource controlled: the network must operate for long periods of time and the nodes are wireless, so the available energy resources—whether batteries, energy harvesting, or both—limit their overall operation. To minimize energy consumption, most of the device's components, including the radio, will likely be turned off most of the time.***

The study of wireless sensor network is challenging in that it requires a huge breadth of knowledge from an huge variety of disciplines. The main paper is to discuss and evaluate the performance of different parameters indifferent scenarios and different ground areas which may be small, very large in wireless sensor network using dynamic source protocol(DSR)for monitoring of critical condition with the help of five parameter(PDF, average END-END delay, average throughput, NRL, packet loss) ratio.

Keywords— Dynamic source routing, End-to-End Delay, Network Simulator, packet delivery fraction, throughput, wireless sensor network

I. INTRODUCTION

A wireless sensor network is composed of many individual sensor "nodes", sometimes referred to as "motes", each with their own individual power, computing, environment sensing, and wireless Communication hardware. The sensors are often scattered at random around a geographically diverse terrain and will then activate and begin to form communication networks with the intent of transmitting a complete "picture" of the environment back to a central location for analysis [1].
This interest has largely been sparked by the dramatic drop in cost, size, and an Increase in range and sensing capability of wireless sensor devices. These developments allow for a world where numerous, large, distributed networks of wireless sensors are a reality [1].

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). [11] The main features of WSNs, as could be deduced by the general description given in the previous sections, are: scalability with respect to the number of nodes in the network, self-organization, self-healing, energy efficiency, a sufficient degree of connectivity among nodes, low-complexity, low cost and size of nodes those protocol architectures and technical solutions providing such features can be considered as a potential framework for the creation of these networks, but, unfortunately, the definition of such a protocol architecture and technical solution is not simple, and the research still needs to work on it[12]. WSNs enable new applications and thus new possible markets; on the other hand, the design is affected by several constraints that call for new paradigms. In fact, the activity of sensing, processing, and communication under limited amount of energy, ignites a cross-layer design approach typically requiring the joint consideration of distributed signal/data processing, medium access control, and communication protocols [13]. The process of standardization in the field of WSNs is very active in the last years and an important outcome is represented by IEEE 802.15.4 which is a short-range communication system intended to provide applications with relaxed throughput and latency requirements in Wireless Personal Area Networks (WPAN)[14].

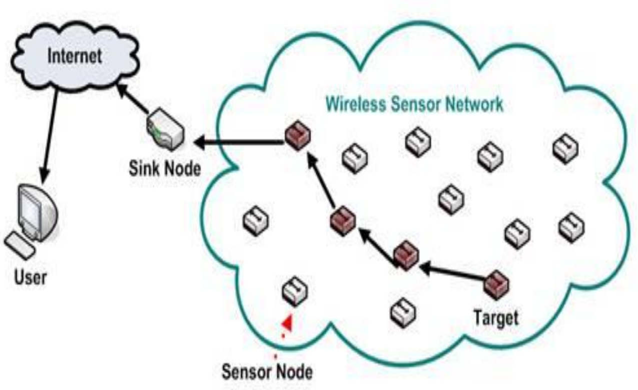

Fig.1: Wireless sensor network

Sensor networks represent a significant improvement over traditional sensors, which are deployed in the following two ways:

1. Sensors can be positioned far from the actual phenomenon, i.e., something known by sense perception. In this approach, large sensors that use some complex techniques to distinguish the targets from environmental noise are required.
2. Several sensors that perform only sensing can be deployed. The positions of the sensors and communications topology are carefully engineered. They transmit time series of the sensed phenomenon to the central nodes where computations are performed and data are fused [15].

Many researchers are currently engaged in developing schemes that fulfill these requirements. In this paper, we present a survey of protocols and algorithms proposed thus far for sensor networks.
Our aim is to provide a better understanding of the current research issues in this field.

II. DESCRIPTION OF ROUTING PROTOCOL

The routing protocol also specifies how routers report changes and share information with the other routers in the network that they can reach. A routing protocol allows the network to dynamically adjust to changing conditions, otherwise all routing decisions have to be predetermined and remain static. Routing is the procedure of directing packets from a resource node to a destination node on a different network. Getting packets to their next hop requires a router to perform two basic activities: *path determination* and *packet switching*. If all the hosts that want to communicate are within programme range of one another, no routing protocol or routing decisions would be necessary. Several routing protocols have been proposed for mobile ad-hoc networks. One such routing protocol is the *Dynamic Source Routing* (DSR) [3,5]. In this thesis, I will analyze the performance of DSR using simulations. Though DSR is designed to be adaptive and suitable for mobile networks, it has been shown to perform poorly at low traffic loads and high node mobility situations [4].

Dynamic Source Routing (DSR) Protocol: DSR is an On-Demand Routing protocol. The major difference between DSR and the other on demand routing protocols is that, it is beacon less and hence does not require periodic hello packets. Consider a source node that does not have a route to the destination. When it has a data packet to be sent to that destination, then it initiates a Route Request packet. This Route Request is flooded throughout the network. The key features of DSR are:
Source Routing – The sender of a data packet knows the complete hop-by-hop route to the Destination. These routes are stored in a *route cache.* Data packets sent by the source node carry the complete route in the packet header. Intermediate nodes forward the packet based on the route in its header. In most cases, the only modification that an intermediate node may make to the header of a packet is to the *hop count* field. The fact that all data packets are Routed from the source has widely perceived security benefits [2, 3].
On-Demand – DSR attempts to reduce routing overhead by only maintaining routes between nodes taking part in data communication. The source discovers routes on-demand by initiating a route discovery process only when it needs to send a data packet to a given destination [2, 3].

III. SIMULATION TOOLS

Simulation is distinct as the process of designing a model of a real system and conducting experiments with this model for the function of understanding the behavior of the system and/or evaluating various strategies for the operation of the system. The C++ classes of ns-2 network components or protocols are implemented in the subdirectory "ns-2", and the TCL library in the subdirectory of "tcl". NS2 is simply an event driven simulation tool that has proved useful in studying the dynamic nature of communication networks. **NS-2** provides the substantial support to simulate bunch of protocols like TCP, UDP, FTP and HTTP. Ns-2 is discrete event simulator i.e. timing of events is maintained in a scheduler NS is Object-oriented Tcl (OTcl) script interpreter that has a simulation event scheduler and network component object libraries, and network setup (plumbing) module libraries. Our programming is done is OTcl script language if we want to run network simulator. An OTcl script should be written to setup and run a simulation network, which initiates an event scheduler, sets up the network topology using the network objects and the measuring functions in the library, and tells traffic sources when to start and stop transmitting packets through the event scheduler [6]. In this manner the basic translation of the script is achieved and the simulation can execute. Tracing during the simulation can capture the simulation results in two different ways. If the purpose of tracing is the visualization of the script, then there is an option of tracing for the network animator (name). However, if the purpose is to perform analysis of the behavior described by the script, then a different command captures the appropriate measures in a file and also provides the option of generating a comparison graph [7].

IV. SIMULATION PARAMETER

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

1. 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 [16].
2. 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.
3. 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 [17].
4. Normalized Routing Load (NRL)**:** It is the number of route control packets per data packet delivered a destination end. It is important to measure the scalability of routing protocol; the adaption to low bandwidth environment and its efficiency in relation to sensor node battery power. Sending more routing packets may increase the probability of packet collision. As a result end-to-end delay may increase and decrease the PDR as well [18].
5. Packet loss [%]: It is the number of dropped packet to the total packets. Packet loss is the general term to describe a lost chunk of data (packet or packets) within the transmission time frame of interest. Packet loss could be described at the higher application levels if a mapping between the IP layer and the higher application layer exists [19].

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.

In this paper we selected to investigated DSR protocol for different performance parameters for different Terrain areas like small (1 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 1km. x 1km.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.

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, 100sec
7	Terrain Area	1 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

VII. RESULT AND ANALYSIS:

(a)The investigations were performed on Parameters such as Packet Delivery Fraction (pdf) using DSR protocol. When Nodes-100, Pause Time - 0-100secs, Maximum Speed 10m/s, Routing protocol- DSR, and Evaluating Parameter- Packet Delivery Fraction.

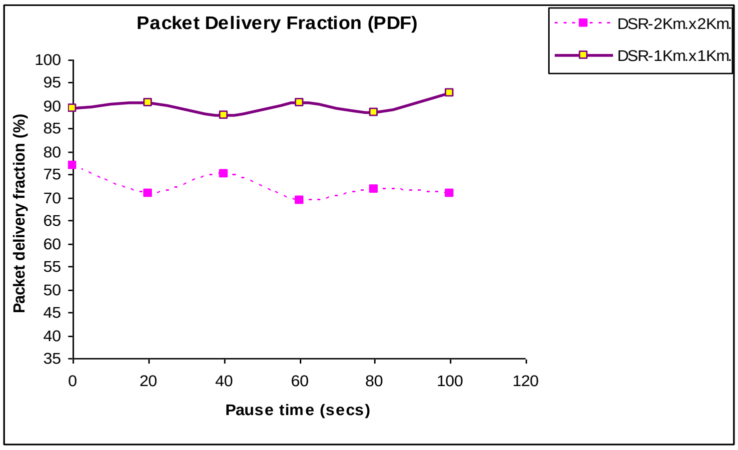

Fig 2: Pause time versus packet delivery fraction when terrain areas are 1 Km. x 1 Km., 2 Km. x 2 Km. for DSR.

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. and 2 Km. x 2 Km. terrain areas, we examine that Packet Delivery Fraction in 1 Km. x 1 Km. is more optimal than 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.

(b) The investigations were performed on Parameters such as Average End-End Delay using DSR protocol.

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

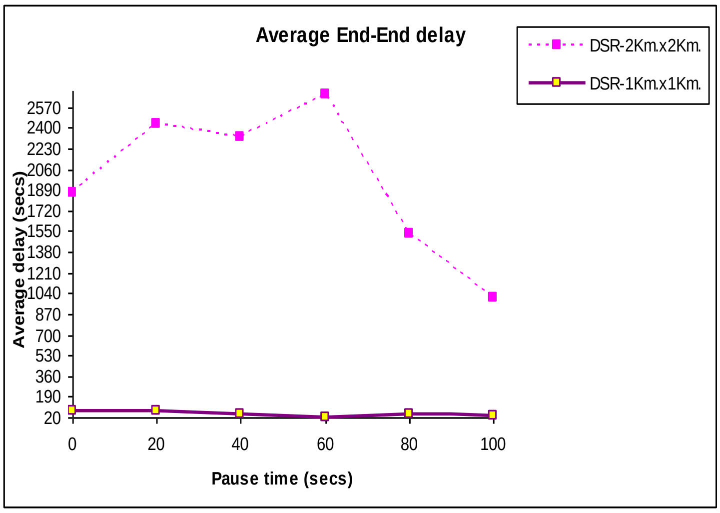

Fig 3: Pause time versus Average End-End Delay when terrain areas is 1 Km. x 1 Km,2 Km. x 2 Km. for DSR.

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., and 2 Km. x 2 Km. terrain areas, we examine that Average End-End Delay in 2 Km. x 2 Km. is more optimal than 1 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.

(c) The investigations were performed on Parameters such as Average throughput using DSR protocol.

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

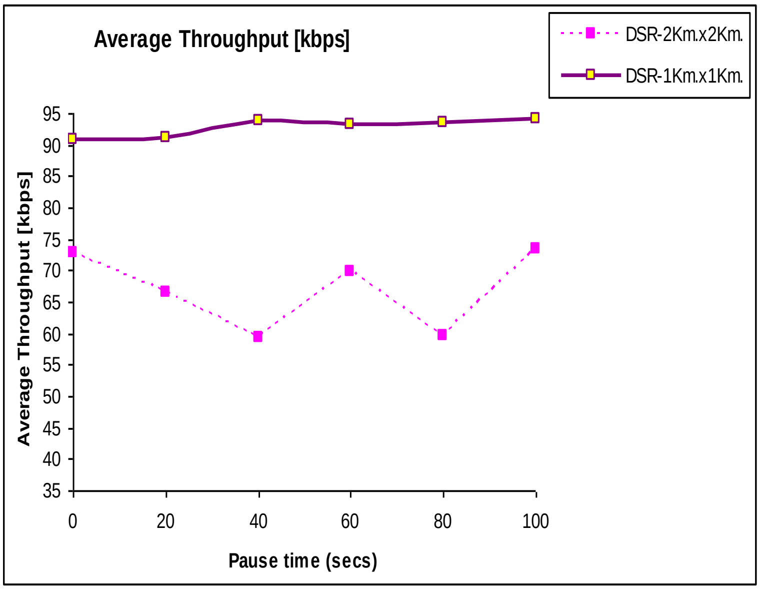

Fig 4: Pause time versus Average Throughput (kbps) when terrain areas are 1 Km. x 1 Km., 2 Km. x 2 Km for DSR.

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., 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 2 Km. So if we implement wireless sensors in biggest terrain areas, the Average Throughput is decreased on varying pause time.

(d)) The investigations were performed on Parameters such as normalized routing load(NRL)DSR protocol.

When Nodes-100, Pause Time - 0-100secs, Maximum Speed- 10m\s, Routing protocol- DSR, and Evaluating Parameter: normalized routing load(NRL).

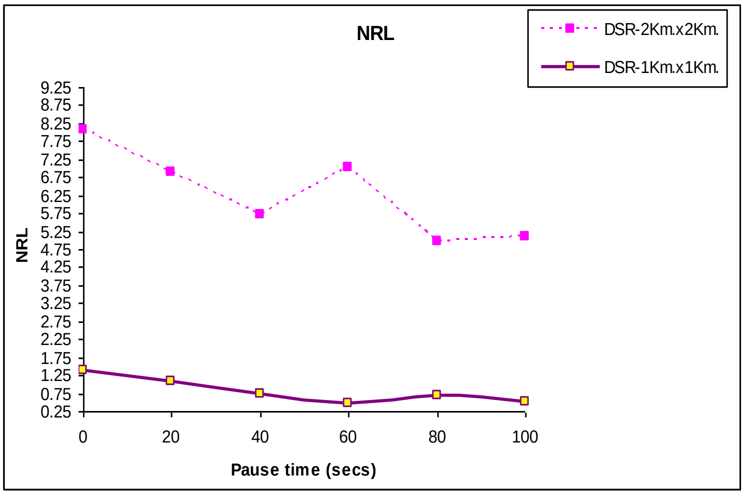

Fig 5: Pause time versus normalized routing load(NRL).when terrain areas are 1 Km. x 1 Km., 2 Km. x 2 Km for DSR.

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., and 2 Km. x 2 Km. terrain areas, we examine that normalized routing load (NRL) in 1 Km. x 1 Km. is more optimal than 2 Km. x 2 Km. So if we implement wireless sensors in biggest terrain areas, the normalized routing load(NRL)is decreased on varying pause time.

(e) The investigations were performed on Parameters such as packet loss [%] DSR protocol.

When Nodes-100, Pause Time - 0-100secs, Maximum Speed- 10m\s, Routing protocol- DSR, and Evaluating Parameter: packet loss[%].

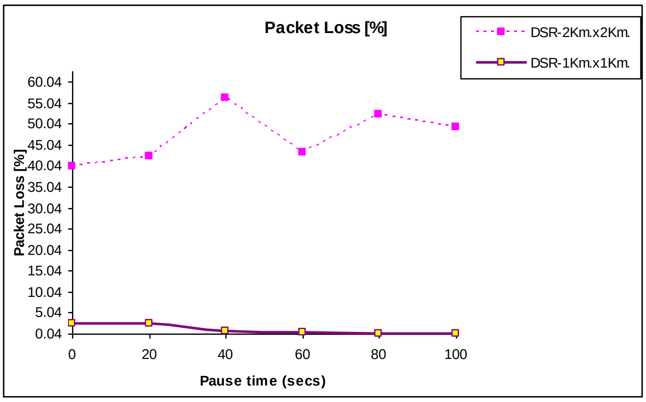

Fig 6: Pause time versus packet loss[%] when terrain areas are 1 Km. x 1 Km., 2 Km. x 2 Km for DSR.

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., and 2 Km. x 2 Km. terrain areas, we examine that packet loss[%] in minimal for simple 1 Km. x 1 Km. and increased for higher 2 Km. x 2 Km. So if we implement wireless sensors in biggest terrain areas, the general is increased on varying pause time.

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 (00-100 secs with interval of 20 secs.) for evaluating performance of different parameters like Packet Delivery Fraction, Average Throughput , Average End-End Delay, normalized routing load(NRL) and packet loss[%] in small, 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 generated graph. Each case represents a special issue for metric and Terrain area (which is small (1 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.), 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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