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

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Abstract*— A wireless sensor network is an assortment of nodes structured into a cooperative network. It is a group of small sensor nodes and wireless communication capabilities. Each node consists of privilege capability may contain numerous types of memory have an RF transceiver, have a power source and accommodate various sensors. Wireless Sensor Networks (WSNs) consist of small nodes with sensing, computation, and wireless communications capabilities. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue [2]. Wireless Sensor Networks (WSN) is intended for monitoring an environment. The main task of a wireless sensor node is to sense and collect data from a definite domain, process them and convey it to the sink where the application lies. DSR has been implemented by numerous groups, and deployed on several test beds. Networks using the DSR protocol have been connected to the Internet. DSR can interoperate with Mobile IP, and nodes using Mobile IP and DSR have seamlessly migrated between WLANs, cellular data services, and DSR mobile ad hoc networks [1]. The Dynamic Source Routing (DSR) protocol is a source-routed on-demand protocol [1]. There are two major phases for the DSR routing protocol: route discovery and route maintenance. Route discovery allows any host in the ad hoc network to dynamically discover a route to any other host in the ad hoc network, whether directly reachable within wireless transmission range. A host initiating a route discovery broadcasts a route request packet which may be received by those hosts within wireless transmission range of it. The route request packet identifies the host, referred to as the target of the route discovery, for which the route is requested. If the route discovery is successful the initiating host receives a route reply packet listing a sequence of network hops through which it may reach the target. The main difference between DSR and other protocols is the routing information is contained in the packet header. Since the routing information is contained in the packet header then the intermediate nodes do not need to maintain routing information. An intermediate node may aspiration to record the routing information in its tables to improve recital but it is not mandatory. DSR also supports asymmetric links as a route reply can be piggybacked onto a new route request packet. DSR is suited for small to medium sized networks as its overhead can scale all the way down to zero. The overhead will increase significantly for networks with larger hop diameters as more routing information will be contained in the packet headers [3]. The study of wireless sensor networks is challenging in that it requires an enormous breadth of knowledge from an enormous variety of disciplines. 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 and large in wireless sensor network using Dynamic Source routing protocol (DSR) for monitoring of critical conditions with the help of parameter Packet delivery fraction (PDF), Average Throughput and Packet Loss. In this study investigators use a scenario for DSR routing protocol where a total of 100 nodes are used with the maximum connection number 10; seed for the one, and a hope that have 10 CBR; 4 packets per second transfer rate and the pause time is varying of 0.00 sec, 10sec, 20sec, 30sec, 40sec, and 50sec implemented respectively in a 100 m x 100 m and 1000 m x 1000 m terrain areas scope. The simulation time was taken to be of 50 seconds.

Keywords*— Dynamic source Routing, Packet delivery fraction, Average Throughput, Packet Loss, Dynamic source routing, Wireless Sensor Networks

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I. INTRODUCTION

Wireless ad hoc network is a collection of autonomous mobile nodes that communicate with each other over wireless links. WIRELESS networks are rapidly becoming a commonplace: Wi-Fi cards are built in computing devices as a standard configuration; hotspots are installed in more and more places, such as campuses, offices, and hotels. Soon, numerous mobile and embedded devices will join the revolution of pervasive computing. This leads us to envision future large networks where hosts communicate with each other in an ad hoc manner. Such networks are generally termed as mobile ad hoc networks (MANETs). Routing has always been one of the key challenges in MANETs and the challenge becomes more difficult when the network size increases. Many routing protocols for MANETs have been proposed (see [4] for a review) and these protocols can be classified into different categories according to different criteria. If classified by the manner in which they react to network topology changes, routing protocols can be grouped into proactive (or table-driven) protocols and reactive (or on-demand) protocols (though several hybrid protocols exist). If classified by the role of routing nodes and the organization of the network, routing protocols can be grouped into flat protocols and hierarchical protocols. [4][7]

In general the two types of wireless sensor networks are: unstructured and structured. The structured wireless sensor networks are those in which the sensor nodes deployment is in a planned manner whereas unstructured wireless sensor networks are the one in which sensor nodes deployment is in an ad-hoc manner. As there is no fixed infrastructure between wireless sensor networks for communication, routing becomes an issue in large number of sensor nodes deployed along with other challenges of manufacturing, design and management of these networks. There are different protocols that have been proposed for these issues. The critical condition monitoring application is studied in this thesis by evaluation of two routing protocols with the help of some performance metrics considering applications demand as well. [3]

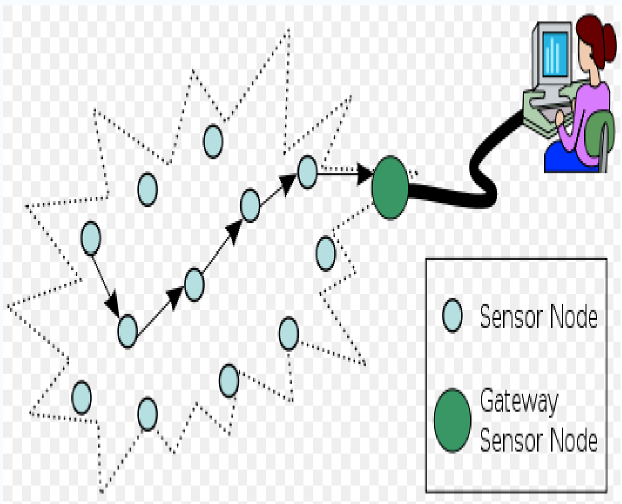

Figure 1: Architecture of Wireless Sensor Network [5]

A sensor network normally constitutes a wireless ad-hoc network, meaning that each sensor supports a multi-hop routing algorithm (several nodes may forward data packets to the base station). Wireless sensor networks have the potential to become significant subsystems of ecological experiment. Sensor networks consist of large number of tiny sensor nodes, all of which have sensing capabilities. These networks allow coordinated signal detection, monitoring, and tracking to enable sensor nodes to simultaneously capture geographically distinct measurements. Wireless sensor networks have limited resources and tight energy budgets. These constraints make in-network processing a prerequisite for scalable and long-lived applications. However, as sensor networks are embedded in uncontrolled environments, a user often does not know exactly what the sensor data will look like, and so must be able to reprogram sensor network nodes after deployment.

II. ROUTING PROTOCOLS

In this section we establish 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. 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. [8]

Routing protocols in conventional wired networks generally use either distance vector or link state routing algorithms. In distance vector routing each router broadcasts to each of its neighbour routers its view of the distance to all hosts, and each router computes the shortest path to each host based on the information advertised by each of its neighbours. DSR is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. [5] DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. The protocol is composed of the two main mechanisms of "Route Discovery" and "Route Maintenance", which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network. All aspects of the protocol operate entirely on demand, allowing the routing packet overhead of DSR to scale automatically to only what is needed to react to changes in the routes currently in use. The protocol allows multiple routes to any destination and allows each sender to select and control the routes used in routing its packets, for example, for use in load balancing or for increased robustness. Other advantages of the DSR protocol include easily guaranteed loop- free routing, operation in networks containing unidirectional links, use of only "soft state" in routing, and very rapid recovery when routes in the network change. The DSR protocol is designed mainly for mobile ad hoc networks of up to about two hundred nodes and is designed to work well even with very high rates of mobility.

As mentioned before, DSR uses source routing, i.e. the source determines the complete sequence of hops that each packet should traverse. This requires that the sequence of hops is included in each packet's header. A negative consequence of this is the routing overhead every packet has to carry. However, one big advantage is that intermediate nodes can learn routes from the source routes in the packets they receive. Since finding a route is generally a costly operation in terms of time, bandwidth and energy, this is a strong argument for using source routing. Another advantage of source routing is that it avoids the need for up-to-date routing information in the intermediate nodes through which the packets are forwarded since all necessary routing information is included in the packets. Finally, it avoids routing loops easily because the complete route is determined by a single node instead of making the decision hop-by-hop. [11]

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.Ns-2 is a packet-level simulator and essentially a centric discrete event scheduler to schedule the events such as packet and timer expiration. Centric event scheduler cannot accurately emulate "events handled at the same time" in real world, that is, events are handled one by one. 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. Simulation of wired as well as wireless network functions and protocols (e.g., routing algorithms, TCP, UDP) can be done using NS2. In general, NS2 provides users with a way of specifying such network protocols and simulating their corresponding behaviors [8].

NS2 provides users with executable command ns which take on input argument, the name of a Tcl simulation scripting file. Users are feeding the name of a Tcl simulation script (which sets up a simulation) as an input argument of an NS2 executable command ns. NS-2 provides the Network components like Node, Link, Queue, etc. they are created from the corresponding C++ classes; The other are compound components, that is, they are composed multiple simple C++ classes like Link are composed of Delay (emulating propagation delay) and Queue. We can say that in ns-2, all network components are created, plugged and configured from TCL. NS-2 provides the Event Scheduling that is associated with time. class Event is defined by {time, uid, next, handler}, where time is the scheduling time of the event, uid is the unique id of the event, next is the next scheduling event in the event queue that is a link list, and handler points to the function to handle the event when the event is scheduled. Events are put into the event queue sorted by their time, and scheduled one by one by the event scheduler [11]. NS-2 has four main components: NS itself, Network animator (NAM), Pre-processing and post-processing. The primary component is ns, the actual simulator. This provides the software backup for programming network models. The programming environment provides an interactive mode because the front-end OTcl interpreter allows for the direct programming of the simulator. It is also possible, and often times more efficient, to simply use a text editor to write the scripts and run them from a terminal's command line. [10]

The second component is the network animator or nam. This is a simple animator with two-dimensional (2D) graphics that help the user visualize and monitor the simulation both as a whole, and as individual components. The GUI only requires the trace files (created from the simulation scripts) as input.Pre-Processing and Post-Processing are also important components of NS-2. Examples of Pre-Processing are traffic and topology generators. An example of Post-Processing is simple trace analysis, i.e., xgraph, often developed using scripting languages such as awk, Perl and Tcl. 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. DSR routing protocols can be implemented using Network Simulator 2.29.2. NS is a discrete event simulator targeted at networking research. It provides substantial support for TCP routing and multicast protocols over wired and wireless networks. Using Xgraph (A plotting program) we can create graphical representation of simulation results. All the work is done under linux platform, preferably Cygwin.

IV. SIMULATION PARAMETERS

The following three important performance
metrics are considered for evaluation of the DSR
routing protocols:

1. Packet delivery fraction [%] (PDF): PDF is defined as the ratio of the number of data packets successfully delivered to the destination nodes and number of data packets produced by source nodes.
2. Average Throughput: Throughput is refers to the amount of data transfer from source mode to destination in a specified amount of time.
3. Packet Loss [%]: It is the number of dropped packet to the total packets.

Packet Loss [%] = (dropped Packets/ (total packets)) *100)

V. SIMULATION SETUP

In this paper, we tested and investigated ratio of received to sent using 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., 10 sec., 20 sec., 30 sec., 40 sec., and 50 sec. (i.e. in the steps of 10 sec.) implemented respectively in a 100 m. x 100 m., 1000 m. x 1000 m terrain areas. The simulation time was taken to be of 100 seconds.

Table 1: Simulation Parameter Values

1	Transmitter range	250m
2	Bandwidth	2 Mbps
3	Simulation time	50 sec
4	Number of nodes	100
5	Max Speed	10
6	Pause time	0, 10, 20, 30, 40, 50 sec
7	Terrain Area	100 m. x 100 m., 1000 m. x 1000 m.
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

VI. RESULT AND ANALYSIS

(A) The investigations were performed on Packet delivery fraction using DSR routing protocol. When Nodes-100, Pause Time - 0-50secs, Maximum Speed- 10m/s, Routing protocol- DSR, and Evaluating Parameter- Packet delivery fraction

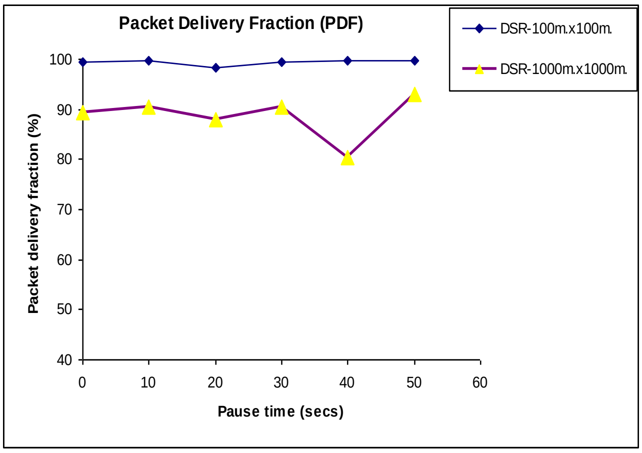

Figure 2: Pause time versus Packet delivery fraction when terrain areas are 100 m. x 100 m., 1000 m. x 1000 m. for DSR

Using the DSR routing Protocol with 100 nodes, maximum Speed 10.00m/s, varying pause time (0-50sec by interval of 10sec) and 100 m. x 100 m. and 1000 m. x 1000 m. terrain areas, we examine that Packet delivery fraction in 100 m. x 100 m is more optimal than 1000 m. x 1000 m. 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 Average Throughput using DSR routing protocol. When Nodes-100, Pause Time - 0-50secs, Maximum Speed- 10m/s, Routing protocol- DSR, and Evaluating Parameter- Average Throughput

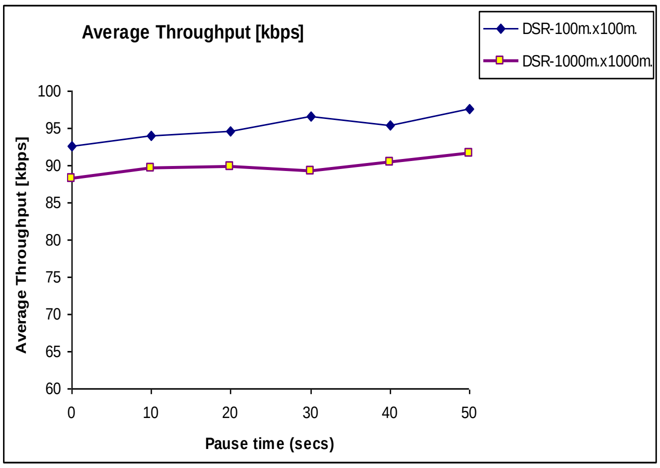

Figure 3: Pause time versus Average Throughput when terrain areas are 100 m. x 100 m., 1000 m. x 1000 m. for DSR

Using the DSR routing Protocol with 100 nodes, maximum Speed 10.00m/s, varying pause time (0-50sec by interval of 10sec) and 100 m. x 100 m. and 1000 m. x 1000 m. terrain areas, we examine that Average Throughput in 100 m. is more optimal than 1000 m. x 1000 m. So if we implement wireless sensors in biggest terrain areas, an Average Throughput is decreased on varying pause time.

(C) The investigations were performed on Packet Loss using DSR routing protocol. When Nodes-100, Pause Time - 0-50secs, Maximum Speed- 10m/s, Routing protocol- DSR, and Evaluating Parameter- Packet Loss.

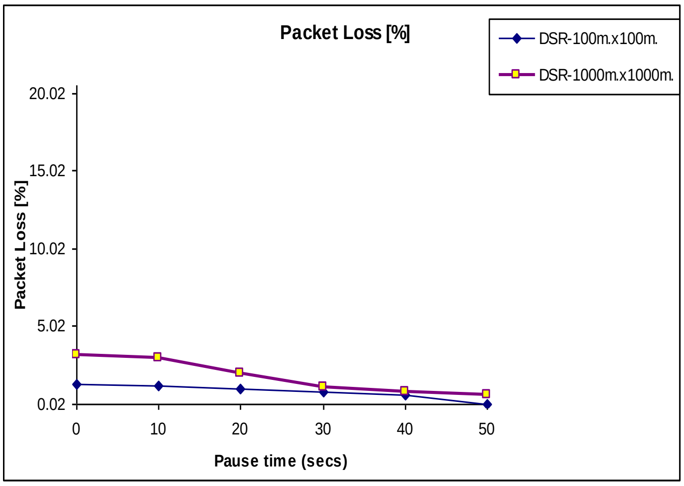

Figure 4: Pause time versus Packet Loss when terrain areas are 100 m. x 100 m., 1000 m. x 1000 m. for DSR

Using the DSR routing Protocol with 100 nodes, maximum Speed 10.00m/s, varying pause time (0-50sec by interval of 10sec) and 100 m. x 100 m. and 1000 m. x 1000 m. terrain areas, we examine that Packet Loss 100 m x 100 m. is less than 1000 m. x 1000 m. So if we implement wireless sensors in biggest terrain areas, the Packet Loss is increased on varying pause time.

VII. CONCLUSIONS

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 (00-50secs with interval of 10secs.) for evaluating packet delivery fraction(PDF), Average Throughput and Packet Loss% in small and 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 (100 m. x 100 m.) and large (1000 m. x 1000 m.). According to the analysis value we plot graphs for different terrain areas, varying the pause time (00-50sec). We use the DSR Routing protocol for performance Metrics Packet delivery fraction, Average Throughput and Packet Loss for 100 m * 100 m terrain area and 1000 m x 1000 m for DSR. We conclude that Packet delivery fraction in 100 m. x 100 m is more optimal than 1000 m. x 1000 m. Using the DSR routing Protocol with 100 nodes, maximum Speed 10.00m/s, varying pause time (0-50sec by interval of 10sec) and 100 m. x 100 m. and 1000 m. x 1000 m. terrain areas, we examine that Average Throughput in 100 m. is more optimal than 1000 m. x 1000 m. Using the DSR routing Protocol with 100 nodes, maximum Speed 10.00m/s, varying pause time (0-50sec by interval of 10sec) and 100 m. x 100 m. and 1000 m. x 1000 m. terrain areas, we examine that Packet Loss 100 m x 100 m. is less than 1000 m. x 1000 m.

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