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Efficient Routing Algorithm for MANET using Grid FSR

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Abstract. Rapid advances in information technology has made it possible to transmit the data in wireless links without the aid of any fixed infrastructure or centralized administrator. Wireless mobile ad hoc networks are self-creating, self-administering and self-organizing entities. In our research work, we present investigations on the behavior of the Proactive Routing Protocol FSR in the Grid by analysis of various parameters. The Performance metrics that are used to evaluate routing protocols are Packet Delivery Ratio (PDR), Network Control Overhead, Normalized Overhead, Throughput and Average End to End Delay. Experimental results reveal that FSR is more efficient in Grid FSR in all QOS constraints. FSR can be used in all Resource critical environments. Grid Fisheye state routing (GFSR) consumes less bandwidth by restricting the propagation of routing control messages in paths formed by alternating gateways and neighbor heads, and allowing the gateways to selectively include routing table entries in their control messages. PDR and Throughput are 100% efficient in Simulation Results in NS2.

Keywords: MANET, Link State Routing (LSR), Fish-eye State Routing Protocol (FSR),Grid Fisheye Routing Protocol(GFSR),NS2, PDR, Throughput, Control Overhead, Normalized Overhead, End to End Delay,Throughput.

1. Introduction

In areas where there is little or no communication infrastructure or the existing infrastructure is expensive or inconvenient to use, wireless mobile users may still be able to communicate through the formation of an ad hoc network [1] [2]. Z. J. Hass and M.R.Pearlman, 1998 et. al., proposed that Mobile ad hoc networks (MANET) consists of a collection of wireless mobile nodes, which dynamically exchange data among themselves without the reliance on a fixed base station or a wired backbone network, it have potential use in a wide variety of disparate situations such as responses to hurricane, tsunami, earthquake, emergency relief, terrorism and military operation. In [1], the author proposed that MANET is a self configuring network composed of mobile nodes without any fixed infrastructure. They provide robust communication in a variety of hostile environment, such as communication for the military or in disaster recovery situation when all infrastructures are down. A very important and necessary issue for mobile ad hoc networks is to find the root between source and destination that is a major technical challenge due to the dynamic topology of the network. Routing protocols for MANET could be different depending on the application and network architecture. In proactive routing protocols each node keeps the routing information in a number of tables. This information is exchanged with other nodes periodically and or when there is a change occurs in the network topology. A number of proactive routing protocols have been proposed. Some of these protocols are DSDV, WRP, GSR, HSR, FSR, OLSR, CGSR, etc. among which FSR and OLSR scale very well in large and highly mobile network.

The rest of this paper is organized as follows: First of all, we make a brief survey on FSR and Grid FSR in section 2. In section 3, description on how GFSR works. Section 4 presents the Simulation Results of performance evaluation of different Parameter Metrics and section 5 concludes the paper.

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2. Related Work

2.1. FSR (Fisheye State Routing)

G. P. Mario, M. Gerla and T.W. Chen, (2000) et.al, proposed that the FSR is a descendant of GSR [2]. In [3], the authors introduce a novel proactive (FSR), the notion of multi-level fisheye scope to reduce routing update overhead in large networks. In [3], the authors proposed that, Fisheye State Routing (FSR) protocol is a proactive (table driven) ad hoc routing protocol and its mechanisms are based on the Link State Routing protocol used in wired networks. This means that FSR scales well to large mobile ad hoc networks as the overhead is controlled and supports high rates of mobility. Fig. 1, explains the Fisheye scope.

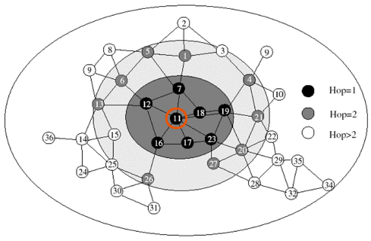

Fig. 1: Fisheye Scope

Y

...	…			
(0,0)	(0,0)	…		
(0,1)	(1,0)	(0,0)	…	
(0,0)	(1,0)	(0,0)	…	

X

Fig. 2: The square is divided into many logical grid

2.2. GRID based Fisheye State Routing Protocol (GFSR)

Fisheye state routing protocol improves traditional link-state routing in the MANET. By adopting the idea of GRID [4] in FSR, we proposed an efficient GRID-based fisheye state routing protocol (GFSR). A gateway is elected in each grid and is the only node in the grid to exchange control messages and data packets with other grids. Simulation shows that GFSR is more efficient than FSR, especially in high-density networks. We can propose a virtual grid-based routing protocol called GFSR to make communication more efficiently under highly-density environment. T-H. Chu and S-I. Hwang, et. al., 2006, proposed that GRID-Based Fisheye State Routing (GFSR) Protocol is an extension to Fisheye State Routing. By adopting the idea of GRID into Fisheye State Routing, fewer forwarding nodes can lower the cost of control messages and can save bandwidth for data transmission. This makes transmission more efficiently, especially in high-density networks. As illustrated in Fig.2, each node can calculate in which grid it currently dwells based on the physical location information derived from GPS. The geographic area of an ad hoc network is partitioned into two dimensional virtual grids and each grid has its unique co-ordinate number (x, y). The node nearest to the physical center of a grid is a good candidate as a gateway.

3. Proposed Work

3.1. Routing Scheme

Each gateway maintains a Routing table by the routing information which is exchanged periodically. When a node needs to transmit data, it checks whether it is a gateway or not. If it is a gateway, it transmits data to next hop by checking its routing table. If it is non-gateway node, it just sends data to its gateway, and then the gateway will take over to forward the message to next hop. In Fig. 3, the gateways along the routing path will check the destination and determine who the next hop should be. When a packet approaches nearer to its destination, the routing information stored in the gateways becomes progressively more accurate. Packets finally arrive at the grid of destination node. If destination is a gateway, the packet is received by that gateway. Initially before data transmission each grid broadcast its grid member's information through gateway node. So that each gateway can exchange its grid members list as the whole network comes under the communication. While data transmission between grid members to other node gateway maintains unicast transmission until reaches its destination. Through this method we propose that there will be no packet loss from source to destination.

3.2. Grid Formation Calculation

Distance between Nodes (DBN) is calculated with the following Equation:

sl_x = MAX-X / X-SCALE + 1, sl_y = MAX_Y / Y-SCALE + 1

$$X - Grid = \forall i < sl - x \qquad x <= 1 * scale \,\&\&\, x >= (l-1) * x - scale$$

$$Y - Grid = \forall i <= sl - y \,, \qquad y <= 1 * y - scale \,\&\&\, y >= (l-1) * y - scale$$

grid – id = (x_grid – 1) x (sl – x + y_grid)

$$\text{DBN} \quad \sum_{i=1}^{n}\sum_{i=1}^{n}\sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \quad \forall i, j$$

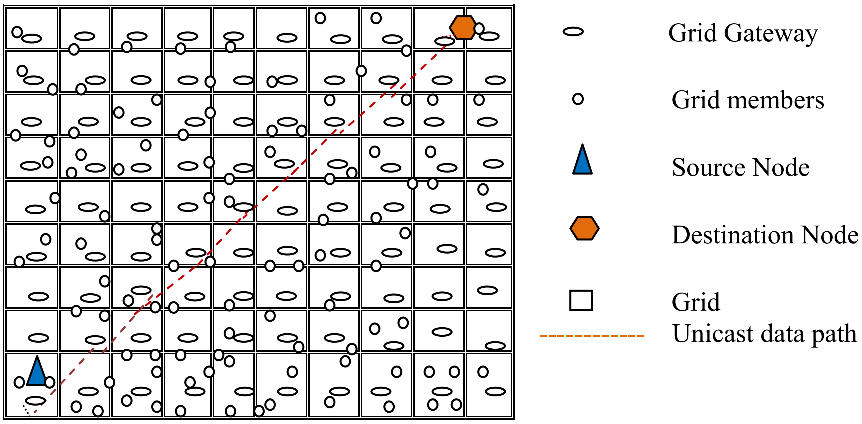

Fig. 3: GRID Architecture with Unicast data path from Source node to Destination Node

4. Simulation Results

To evaluate the performance of routing protocols, both qualitative and quantitative metrics are needed. Most of the routing protocols ensure the qualitative metrics. Therefore, we can use five different quantitative metrics to compare the performance. The proposed GFSR protocol is implemented using NS2 simulator. The performance is measured according to (1) Packet Delivery Ratio with nodes (2) Control message overhead with nodes (3) Normalized Overhead with nodes (4) End to End Delay with Nodes. (5) Throughput.

4.1. Packet Delivery Ratio (PDR) versus Nodes

Packet delivery ratio is an important metric as it describes the loss rate that will be seen by the transport protocols, which run on top of the network layer. It is defined in as the ratio between the number of packets originated by the application layer CBR sources and the number of packets received by the CBR sink at the final destination. N is the number of data sources, CBR *recv* is the total number of CBR packets received and CBR *send* is the total number of CBR packets sent per source. The fraction of packets sent by the application that are received by the receivers. The number of data packets sent from the source to the number of received at the destination. As the calculation, PDR = (control packets sent-delivery packet sent)/control packets sent.

$$PDR = \frac{\sum_{1}^{N} CBR_{recv}}{\sum_{1}^{N} CBR_{send}}$$

As the calculation, PDR = (control packets sent-delivery packet sent)/control packets sent.The result of Packet delivery ratio is illustrated in Fig. 4 with 100% efficiency without any packet loss. So the bandwidth can be saved to transmit data packet. On the contrary, the delivery ratio keeps high when using GFSR scheme. Hence PDR is 100% efficient in GFSR than FSR with 150 nodes.

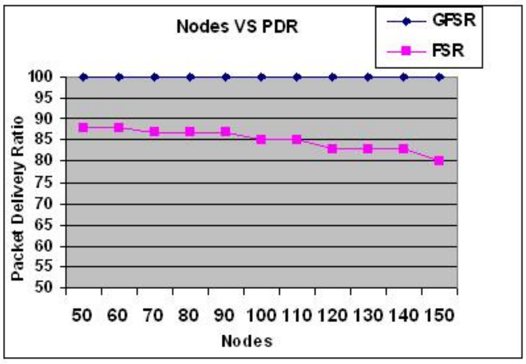

Fig. 4: Packet Delivery Ratio V/s Number of Nodes

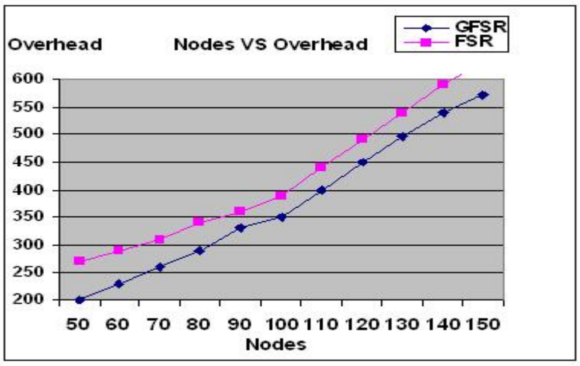

Fig. 5: Control Overhead V/s Number of Nodes

4.2. Control Message Overhead versus Nodes

Network Control overhead (NCO) [6], [7], is used to show the efficiency of the MANET's routing protocol scheme. It is defined, as the ratio of the number of control messages and control packets e.g., RTS, CTS and ACK propagated by each node throughout the network and the number of the data packets received by the destinations. The definition is: NCO = Number of Control Message Sent / Number of Data Received. From Fig.5, it is observed that the network control overhead needed for FSR routing protocol goes down as the data rate increases. This is because the same amounts of routing and control message are needed to route CBR traffic at lower data rate as well as at higher data rate. In GFSR, the control overhead can be reduced substantially. If there are n grids, there are at most n nodes need to exchange routing information. The control messages are exchanged periodically. The result of control overhead is shown in Fig. 5 as it grows slowly. Here, the message overhead still increases with the number of nodes.

4.3. Normalized Overhead versus Nodes

The graphs in Fig. 6, illustrate the Normalized routing overhead. As Figure clearly explains that in GFSR normalized overhead is comparatively reduced than FSR. The routes produced would have been less accurate which may have result in a drop in throughput. This means that accuracy of the routes will be high during high mobility where nodes are more likely to migrate more frequently and experience topology changes, and when mobility is low, less updates are sent. From the result shown in Fig. 6, it can be seen that GFSR produced less overhead than FSR, across all different level of node density.

4.4. Average End-to-End Delay versus Nodes

End-to-end delay indicates how long it took for a packet to travel from the source to the application layer of the destination. Here again GFSR has low delay comparied to FSR.The result in Fig. 7, shows that GFSR's each data packet experiences lower end-to-end delay than in FSR. This is because in our proposed strategies each node generates less route updates than in FSR, which means there is less contention for the channel when a data packet is received. Therefore, each node can forward the data packet more frequently.

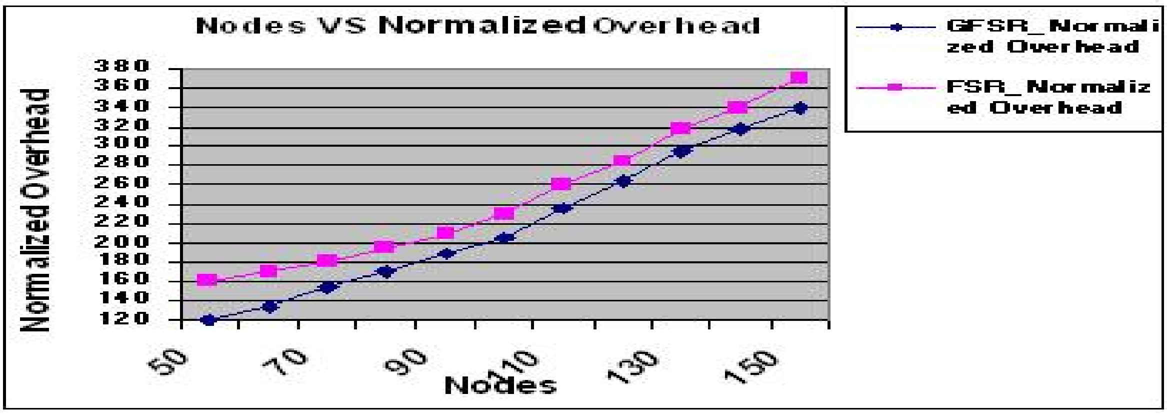

Fig. 6: Normalized Overhead V/s Number of Nodes

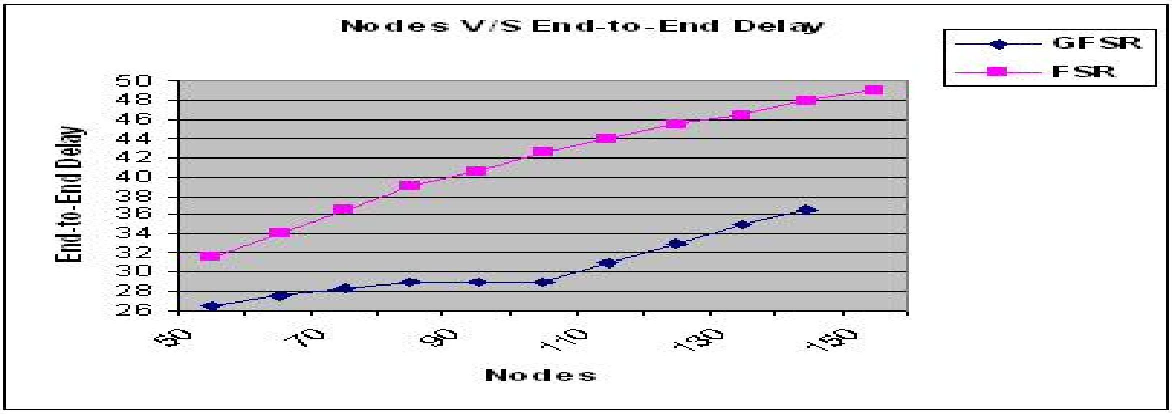

Fig. 7: End to End Delay V/s Number of Nodes

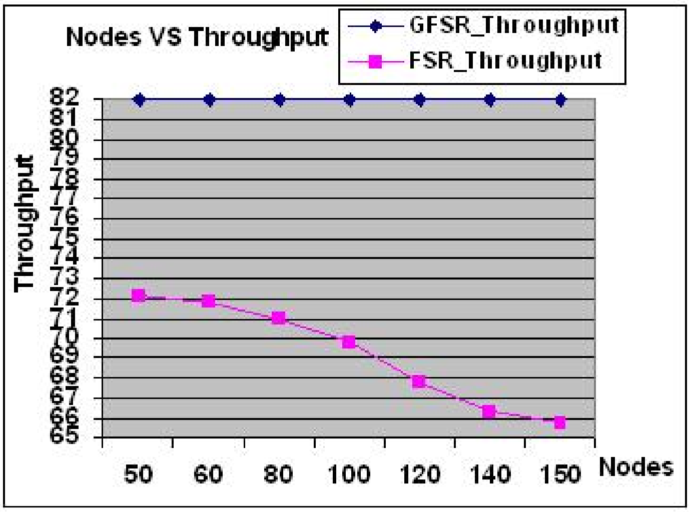

Fig. 8: Throughput V/s Number of Nodes

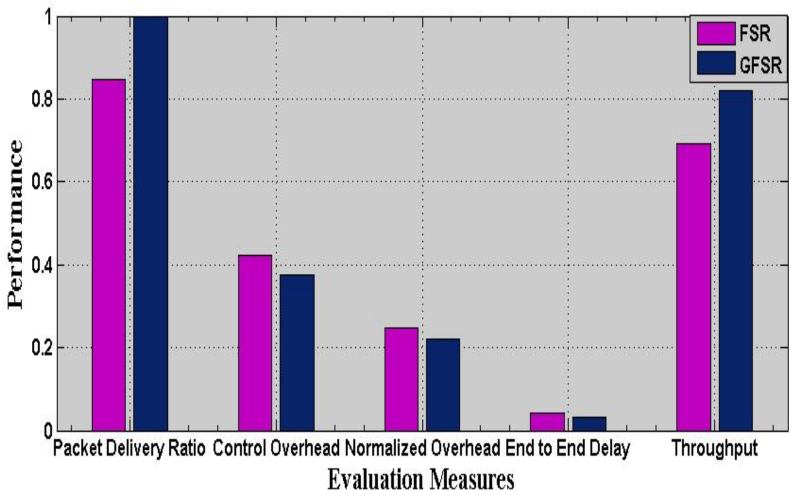

Fig. 9: Average Comparison of FSR and GFSR in NS2

5. Conclusion

Table 1. explains the Comparative Analysis of FSR and GFSR in NS2. This research studies compares FSR and GFSR routing protocols for MANET. PDR and Network control overhead are very important when deciding how reliable a protocol performs. In our Simulation Evaluation terms of Packet delivery ratio and Throughput in GFSR outperforms FSR with 100% without packet loss with lower delay. In this paper, we proposed a new routing Algorithm called Grid FSR. In longer routing path, GFSR provides a highly efficient solution with lower control message overhead and fewer routing nodes which are responsible for

exchanging routing information. In high-density environments, our method exhibits low interference and fewer collisions and leads to more efficient communication among mobile nodes. In future, Energy-efficient routing may be used to maximize network lifetime by reducing flooding in wireless networks. Finally GFSR outperforms and shows its average efficiency in all Simulation parameters in Fig. 9.

Table 1. Comparative Analysis of FSR and GFSR in NS2

Nodes	**Packet Delivery**		**Control Overhead**		**Normalized Overhead**		**End to End Delay**		**Throughput**	
	FSR	**GFSR**	**FSR**	**GFSR**	**FSR**	**GFSR**	**FSR**	**GFSR**	**FSR**	**GFSR**
5	88.0	100.0	275	200	0.16167	0.11758	0.03154	0.02654	72.132	81.968
75	87.0	100.0	315	275	0.18519	0.16167	0.03756	0.02856	71.312	81.968
100	85.0	100.0	385	350	0.22634	0.20576	0.04248	0.02878	69.672	81.968
125	83.0	100.0	515	475	0.30276	0.27925	0.04595	0.03434	67.213	81.968
150	80.0	99.882	628	578	0.36921	0.34020	0.04917	0.03769	65.574	81.871

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7. References

[1] Ashish K.Maurya and Dinesh Singh,Simulation based Performance Comparison of AODV, FSR and ZRP Routing Protocols in MANET", *In International Journal of Computer Applications*, (0975-8887) Vol.12-No.2, Nov.2010.

[2] T. W. Chen and M. Gerla, "Global State Routing: A New Routing Scheme for Ad-hoc Wireless Networks," In *Proceedings of IEEE ICC'98*, Atlanta, GA, Jun.1998, pp. 171-175.

[3] G. P. Mario, M.Gerla and T-W Chen, "Fisheye State Routing: A Routing Scheme for Ad Hoc Wireless Networks, "*Proceedings of the International Conference on Communications*, New Orleans, USA, June 2000, pp. 70 -74.

[4] [4] T-H. Chu and S-I. Hwang, "Efficient Fisheye State Routing Protocol using Virtual Grid in High density Ad Hoc Networks," *Proceedings of the 8thInternational Communication Conference on Advanced Technology*, vol. 3, February 2006, pp. 1475 – 1478.

[5] Z. J.Hass and M. R. Pearlman, "The performance of a new routing protocol for the reconfigurable wireless networks, " *Proceedings of IEEE International Conference on Communications (ICC)*, 1998, p 156-160.

[6] Tanu Preet Singh, Dr. R.K Singh, Jayant Vats.,(2011) " Effect of Quality Parameters on Energy Efficient Routing Protocols in MANETs", *International Journal of computer Science and Technology,*Vol.3,No.7,July 2011.

[7] P.Parameswari, Dr.C.Chandrasekar, "Secured Cache Consistent Scheme for Mobile Ad Hoc Network", *European Journal of Scientific Research,* Vol.50 No.2 (2011), pp. 238-245. (Impact factor: 0.047, Indexed by Scopus)

[8] A. Senthilkumar, Dr.C.Chandrasekar, "Multiple Data-Paths Routing of Probabilistic Approach towards Secure Routing in Wireless Sensor Networks", *European Journal of Scientific Research,* Vol.47 No.4 (2010), pp.618-631. (Impact factor: 0.047, Indexed by Scopus)

[9] M.Umashankar, Dr.C.Chandrasekar,"Energy Efficient Secured Data Fusion Assurance Mechanism for Wireless Sensor Networks",*European Journal of Scientific Research,* Vol.49 No.3 (2011), pp. 333-339.(Impact factor: 0.047, Indexed by Scopus)

[10] S.Mohanapriya, Dr. C. Chandrasekar, "Efficient Multicast Geographic Service Provisioning in Wireless Ad Hoc Networks", *European Journal of Scientific Research*, Vol.50 No.2 (2011), pp. 179-186. (Impact factor:

0.047, Indexed by Scopus).