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An Efficient Multi Path Dynamic Routing Protocol for Computing and Constrained Mobile Ad-hoc Network Environment

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Abstract - Wireless mobile ad-hoc networks are classified as ad-hoc networks with logical connections. These types of networks do not have fixed topology (or physical connections) due to the mobility property of nodes, interference, propagation and loss of path. Because of all these problems the path established between sources to destination is not reliable and efficient path. Hence a dynamic source routing protocol is required for these networks to working properly. Data transfer using this protocol based on shorted path, all packets need to be transferred using same path. The researcher on MANET proposed many Routing algorithms to this task. The main idea of this paper is to study, understand, and analyze the problems with existing routing methods. In the proposed multi path dynamic routing, first identify multi paths exist between source to destination and select best shortest path and then data is segmented into packets, each packet is transferred to receiver using selected best shortest path. At receiver end received data need to be rearranged. Finally the performance proposed system is compared with existing methods and proposed method shows better performance when compared with existing methods.

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GJCST-E Classification : *C.2.2*

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I. Introduction

A personal computer or desktop computer intended for computing purpose. It is fixed in a single location with modern devices. It is mainly working on 1D (one dimension) of computer science area, i.e., computing. Desk top computers are also called as standalone systems. If the person wants to use this category of system, they must be present at room where the system is located, because personal computer is fixed in a single position. The environment setup of standalone systems are shown in figure1.

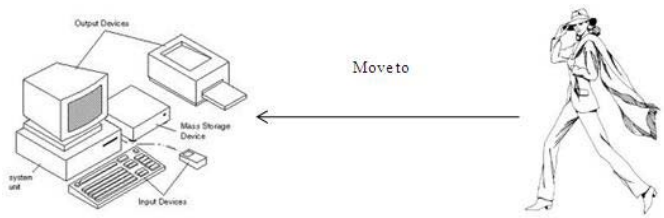

Figure 1 : Standalone system computing environment

Client-server model is architecture of a network in which a lot of clients are inter-connected with server. In this model, Client always request service from server, if the requested service is available immediately it is provided to client. Client system provides an interface to user to request services from the server. Many clients can access information from server simultaneously at the same time; a client computer can execute other tasks, such as sending mails. Both client and server are considering as intelligent systems, the client-server model is completely different from stand alone systems. A client server model working on 2D (two dimensions) of computer science, one is computing and other one is communication. That is, within this model client and server communicate with each other. In this model all the devices are fixed in a standard place. The environment setup of client server model is shown in figure 2.

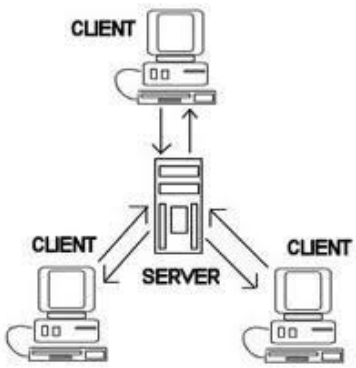

Figure 2 : Client server computing environment

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Mobile computing evolves during the most recent years as a need of portable and growing networks called wireless networks. Mobile computing enlarges the usability of systems, but raises many demanding challenges issues. Mobile computing working on 3D (three dimensions) of computer science, they are computing, communication, and mobility. In mobile computing mobile agents are connecting for computing and also communicating by moving its position. This property is called mobility. Mobile computing is also called as location independent computing.

Mobile computing provides computing for the users are who work from numerous locations. Seamless mobility of mobile agent "connect" from any of the location, at any time based on their convenience of use (no extra setup is required like "plug and play") same computing environment is sufficient, same services, in spite of location Mobile users may be willing to give up some performance for mobility. The environment setup of mobile computing is shown in figure 3.

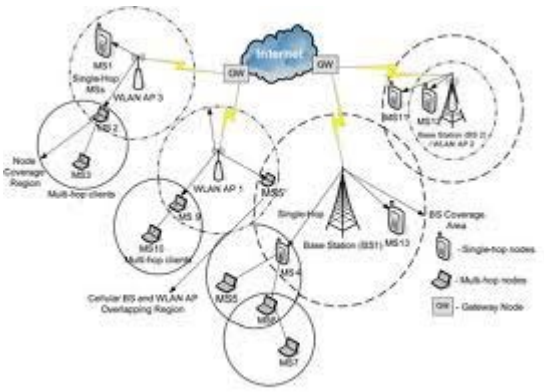

Figure 3 : Mobile computing environment

a) A taxonomy of routing protocols for ad hoc networks

This section provides a short overview of the different aspects of routing protocols for mobile ad hoc networks. Routing protocols are needed whenever delivered data packets need to be handed over several nodes to arrive at their destinations. Routing protocols have to find routes for packet delivery and make sure the packets are delivered to the correct destinations. The existing routing protocols such as distance vector routing and link-state routing were originally designed for static, wired networks and dynamic topology was not considered.

Routing protocols for ad hoc networks can be classified into different categories according to the following criteria:

Pro-active, re-active or hybrid
Centralized or distributed
Dynamic or static

The first criterion will be discussed in the next paragraph. As for the second criterion, when a routing protocol is centralized, all decisions are made at a centre node, whereas in a distributed routing protocol, all nodes cooperate, usually in a symmetric way, in order to reach a routing decision. The third criterion is concerned with the nature of the information used for the routing process. A dynamic protocol may change behavior according to the network status, which can be congestion on a link or many other possible factors. A link may fail unexpectedly, or a new link may be added.

A dynamic routing protocol must discover these changes, automatically adjust its routing tables, and inform other routers of the changes. The process of rebuilding the routing tables based on new information is called convergence. Static protocols on the other hand do not change when the network status changes, the changes must be added manually. An example of a static protocol is flooding; in which a node always retransmits an incoming packet, unless it already sent the same packet earlier.

b) Pro-active, re-active and hybrid protocols

The routing protocols for ad hoc networks can be classified in three different classes: pro-active protocols, re-active protocols and the hybrid protocols. These three classes differ in a number of ways.

Pro-active protocols (or table-driven protocols) work in a way similar to wired networks: they try to maintain an up-to-date map of the network, by continuously evaluating known routes and attempting to discover new ones. This way, when a path to a destination is needed at a node, or a packet needs to be forwarded, the route is already known and there is no extra delay due to route discovery. On the other hand, keeping the information up-to-date this way may require a lot of bandwidth, which is sparse, and battery power, which is limited in mobile ad hoc networks and even then information may still be out-of-date. The Distance-Vector protocols fall in the pro-active class.

Unlike pro-active protocols, re-active protocols (on-demand protocols) only start a route discovery procedure when needed. When a route from a source to a destination is needed, some sort of global search procedure is started. This does not require the constant updates being sent through the network, as in pro-active protocols, but it does cause delays, since the routes are not available and need to be found. In some cases the desired route(s) are still in the route cache maintained by nodes. When this is the case there is no additional delay since routes do not have to be discovered. Protocols such as DSR and AODV [1] are members of the re-active protocol class.

Pure pro-active protocols are likely not fit for ad hoc networks where nodes move a lot, because of the high traffic overhead caused by continuously updating the network information. On the other hand, pure re-active protocols may also have their problems; extreme delays and excessive control traffic, may make them unfit for certain applications.

Hybrid protocols combine the advantages of both pro-active and re-active routing, by locally using pro-active routing and inter-locally using re-active routing. This is partly based on the assumption that most communication in mobile ad hoc networks takes place between nodes that are close to each other, and the assumption that changes in topology are only important if they happen in the vicinity of a node. When a link fails or a node disappears on the other side of the network, it has only effect on local neighborhoods; nodes on the other side of the network are not affected. The ZRP is an example of a hybrid routing protocol.

Mobile ad hoc networks are deployed currently since they provide some features which are difficult or impossible to be emulated by conventional networks. MENET applications are range from the defense sector to general transportation to providing useful infrastructure during disaster recovery. Because of the significance attached to the applications of Mobile ad-Hoc networks security in ad-hoc networks is a latest research area and already substantial research is done in this field.

Routing plays a very important role in mobile ad-hoc networks which has been done by routing protocols and is used to route the packets depending on the path constraints. The design of network routing protocols for mobile ad-hoc networks is a challenging problem. These ad-hoc networks need efficient algorithms to determine network topology, link connectivity, and routing. A best approach is to consider routing algorithms in which network connectivity is determined in the process of establishing routes. Routing in a decentralized environment where network topology fluctuates is not a well-defined problem. The shortest path from a source to a destination in a static network is usually the optimal route this idea is not fit for mobile computing. The network should be able to adaptively alter routing paths to alleviate if any of these problems arises.

Most of the wireless ad-hoc networks probably prepare single source shortest path between participating nodes to transfer data. But, with shortest path some problems are occurred due to limited bandwidth. Route overhead is the one of the burning issue in shortest path routing protocols (all packets are transfer using same path, one packet is under transmission rest of the packets are in waiting stage, so the total turnaround time is increased). Hence we propose a new method of multi path dynamic routing protocols to address route overhead problem, where each packet use one of the path from multiple paths exist between participating nodes.

The main motivation is to identify the list problems in mobile ad-hoc networks like reducing the delay and route overhead occurred in single source shortest path.

The primary goals of this paper are to reduce transmission delay, route overhead between participating nodes in mobile ad-hoc networks using multi path dynamic routing instead of conventional shortest path routing.

Wireless mobile ad-hoc networks are classified as networks where nodes are logically connected with each other. These types of networks do not have fixed topology due to the mobility property of nodes, interference, propagation and loss of path. Hence a dynamic source routing protocol is required for these networks to working properly. Data transfer using this protocol based on shorted path, all packets need to be transferred using same path. The researcher on MANET proposed many Routing algorithms to this task. The main idea of this dissertation is to study, understand, and analyze the problems with existing routing methods. In the proposed multi path dynamic routing, first identify multi paths exist between source to destination and select best four paths and then data is segmented into four parts, each part is transferred to receiver using different paths which are already selected. At receiver end received data need to be rearranged. Finally the performance proposed system is compared with existing methods and proposed method shows better performance when compared with existing methods.

The remaining sections of the paper are structured as follows. We begin by describing the problem statement and objectives of the paper in section 2. In section 3, we present a new architecture of proposed system. In section 4, we discuss experimental setup of our proposed system. In section 5, discuss related work. Finally, section 6 gives conclusions and direction of future work.

II. Problem Description

Current Ad-hoc routing protocols inherently trust all participants. Most Ad-hoc routing protocols are cooperative by nature and depend on neighboring nodes to route packets. This naive trust model allows malicious nodes to paralyze an Ad-hoc network by inserting erroneous routing updates, replaying old messages, changing routing updates or advertising incorrect routing information. Mobile ad-hoc network research is extended by using some factors. Factors such as power expended, variable wireless link quality, propagation path loss, fading, multi-user interference, and topological changes, become relevant issues.

Unlike their wired counterparts, design of software for mobile devices must consider resource limitation, battery power and display size. Consequently, new hardware and software techniques must be developed. Many Problems are exist with Ad-hoc routing protocols. The previous Researchers proposed many methods for transfer of data from one mobile agent to other. The Research dissertation studies a set of problems that are faced during mobile computing. A

mobile user must be able to deal with the problems like slow even though expensive connection lines, frequent interruption of connection to failures, limited mobile host performance. Requirements for mobile agent services are stability, bandwidth or cost considerations, integration into the well-known environment, application transparency, and extendibility. Proposed method for ad-hoc networks maximize total network throughput by using all available nodes for routing and forwarding.

There are two major differences between their proposals and existing methods. First, we construct multiple paths for the destination network and with the help of the performance monitoring ours may provide route with better performance. Second ours can get some novel paths that are not obtained by the existing one. Ad-hoc networks maximize total network throughput by using all available nodes for routing and forwarding. However a node may misbehave by agreeing to forward packets and then failing to do so, because it is overloaded, selfish, malicious or broken. Misbehaving nodes can be a significant problem. Although the average loss in throughput due to misbehaving nodes is not too high, in the worst case it is very high.

Researchers in mobile computing proposed many methods to transmit data from one mobile agent to other based shortest path and moreover they routes may be static routing or dynamic routing. These methods estimated the network bandwidth before transmit the data, and also select a single path to transmit data. Suppose bandwidth is greater than the data size, data is segmented into packets and packet are numbered with serial numbers and transferred to receiver. At receiver end all the packets are rearranged to restore original data. This research dissertation intended to address some of the problems and limitations of the use of single source shortest path static/dynamic routing. Problem with single source shortest is all packets are travelled using single path, route overhead, traffic, heavy load problems are raised. This method focuses on the following objectives:

- Focusing on the role of mobile agent and identifying list problems when a document is transfer from one mobile agent to other. Studying the solutions to these problems.
- Identification of dynamic routing between mobile agents.
- Presenting the method which is used to identify multiple paths from source mobile host to destination mobile host.
- Examining a number of available techniques that can be applied to distribute data from one mobile agent to other by solving these problems to achieve better performance.

III. Architecture

Sender side architecture of proposed system is shown in figure 4. The main idea of proposed system is to use some routes from all pair shortest path between source mobile hosts to destination host. Architecture of proposed model has following components:

- Job size estimation
- Bandwidth estimation
- Load analyzer
- Job dispatcher
- Route decider

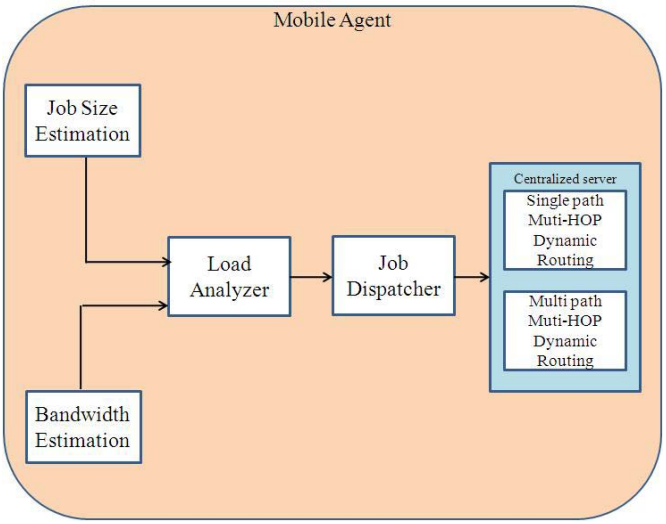

Figure 4 : Architecture of Mobile Agent at Sender Side

Source mobile agent generates a message or data and then size of the generated job is estimated. Find multiple paths from source to destination. Arrange paths based on distances and choose best paths. Next, estimate the network bandwidth. Data /job size is greater than network bandwidth then job is segmented into four smaller jobs and each job is dispatched through one shortest paths. So, all smaller jobs are transmitted to receiver through different channel which reduces route overhead and network traffic.

Receiver side architecture of proposed system is shown in figure 5. Architecture of proposed model has following components:

- Job receiver
- Job reassembly
- Display contents
- Job size Estimation

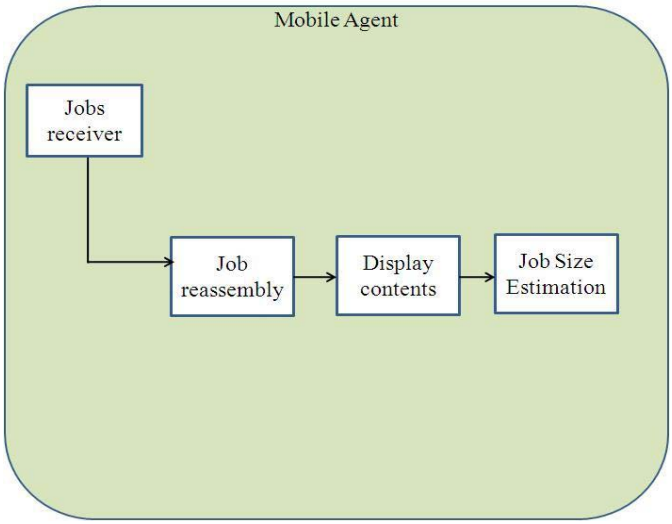

Figure 5 : Architecture of Mobile Agent at Receiver Side

At the receiver end first receiver receives data from various routes and rearranges the data into an order and final data is displayed to the user. At the receiver end received data size is estimated and it is compared with actual size. If both are equal then there is no loss of information or data during transit.

IV. Experimental Results and Discussions

The experimental set of the proposed system is shown in figure 6, network is setup with 42 nodes (seven columns and six rows), and all these nodes are wireless nodes.

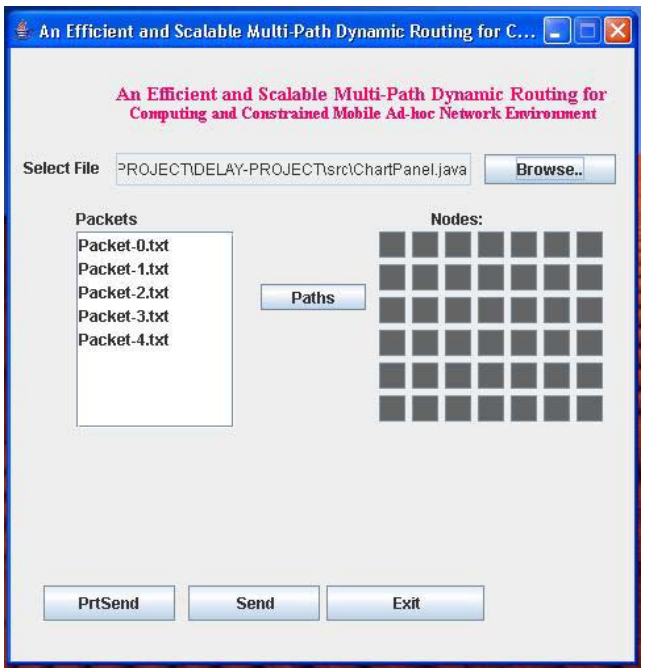

Figure 6 : Experimental Setup

Connections between these nodes are established dynamically, based on the necessity. Then the mobile node has to select a file to transfer to destination, once file is selected by the mobile user, immediately it is segmented into packets based on size of the file, for instance selected file is segmented into five packets is shown in the packet window. After segmentation process mobile agent select paths, for example source node is ACT0 and destination is ACT41, then multiple paths between source to destination is depicted in figure 7. Then send packets to destination using single or multiple paths.

Figure 7 : Multiple path from source to destination

At destination side, maintain a watch window to see route and how many packets received it is shown in figure 8 and 9, arrival time of packets are calculated and is shown in figure 10.

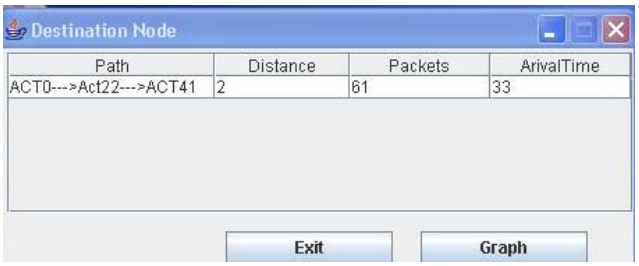

Figure 8 : Destination Node

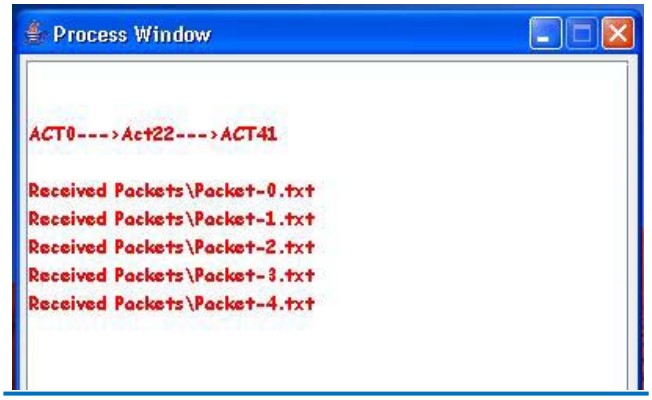

Figure 9 : Process Window

Figure 10 : Total arrival time of packets

Existing methods of data transfer using static or dynamic routing algorithm uses a single source shortest path. Let data is divided into N packets. In order to transmit a packet using shortest path requires N units of time. To transfer N packets requires N * N units of time. Therefore total time complexity is O (N2). In our proposed scheme data is divided into packets and each packet is transmitted through a single path from four selected shortest path. Therefore in order to transmit complete data N units of time is required; the time complexity of proposed system is approximately equal to O (N). Proposed method shows better performance when compared with existing methods.

V. Related Work

Previous works have considered single source shortest path routing approaches to improve path performance and multiplicity. For example, miro [9], rbgp[10], yamr [11] and path splicing [12] also allow for discovery of additional inter domain routes besides BGP. Path Splicing gives a new routing primitive using splicing bits to accomplish the inter domain routing. Although it can bring up with the flexibility of the route selection, it does not essentially add new routes. RBGP and YAMR, through pre computing a few strategically chosen failover paths, ensure that Internet domains stay connected as long as the underlying network is connected. This method is used to avoid the link failure but cannot provide the path multiplicity and flexibility. Ours can not only avoid the link failure but also can select the routes with the higher performance.

In [5, 6], the structure and components of mobile backbone based on ad hoc wireless networks are defined. A Mobile Backbone Network (MBN) consists of a backbone network (Bnet), access networks (Anets), and regular ad hoc networks. Thick solid lines connecting large solid circles represent the Bnet. Dashed ovals consisting of thin solid lines connecting small solid circles represent the Anets. The small solid circles and the thin dashed lines connecting them to each other represent the regular ad hoc networks. MBN is designed so that it involves a sufficient but not excessive number of backbone nodes, while providing high coverage, so that a high fraction of the low-power nodes can access at least Backbone Node (BN) through one hop.

A problem with the use of distance vector routing protocols in networks where hosts are moving, is the likelihood of forming routing loops. In order to eliminate this likelihood, Perkins and Bhagwat have newly proposed adding sequence numbers to routing updates in Destination-Sequenced Distance Vector (DSDV) protocol [16]. These sequence numbers are used to match up to the age of information in a routing update, and allow each node to preferentially choose routes based on the fresh information. DSDV also uses trigger routing update to speed route convergence. In order to damp route variation and reduce congestion from large numbers of trigger updates after a route changes, each node in DSDV maintain information about the frequency with which it seems route changes and may delay some routing updates.

Dynamic source routing protocol is an approach to few source routing protocols used in wired r wireless networks, such as in the IEEE 802 SRT Bridge [17]. Route request packet serves basically the same role in route finding as an “all paths explorer” packet. But, in wired networks, a bridge can copy an all paths explorer from one network interface onto other interfaces and that the explorer will flood the network in a logical and complete way. Some protocol includes optimizations such as caching h sender address, request id i pairs to efficiently overflow explorers through a wireless network. We can also make extensive use of caching and can successfully make use of promiscuous receive mode in the network interface to optimize dynamic route discovery.

VI. Conclusion

The previous Researchers proposed many methods to transfer of data from one mobile agent to other. The Research dissertation studies a set of problems that are faced during mobile computing. A mobile user must be able to deal with the problems like slow even though expensive connection lines, frequent interruption of connection to failures, limited mobile host performance. Requirements for mobile agent services are stability, bandwidth or cost considerations, integration into the well-known environment, application transparency, and extendibility. Proposed method for ad-hoc networks maximize total network throughput by using all available nodes for routing and forwarding.

The research study reveals that, proactive (DSDV) routing protocol consumes more and more bandwidth, because of the frequent broadcasting of routing updated information. While the Reactive protocol (AODV) is somewhat better than DSDV as it doesn’t maintain routing tables at nodes which results in less overhead and more bandwidth. In mobile computing many methods are used to transmit data from one mobile agent to other based shortest path and moreover they routes may be static routing or dynamic routing. These methods estimated the network bandwidth before transmit the data, and also select a single path to transmit data. All the data is transmitted using a single path only. In our proposed method data is segmented into four parts and each part is transmitted to receiver using different paths, which reduces transmission time. Proposed method shows better performance when compared with existing methods. in the proposed method only we consider file size and shortest path, in future we are planning to add

some more parameters like cost to increase the quality of service.

References Références Referencias

1. IEEE Draft Standard P802.16j/D5, "Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems – Multihop Relay Specification," May 2008.
2. Johnson Kuruvila, AmiyaNayak, and Ivan Stojmenovic. Greedy localized routing for maximizing probability of delivery in wireless ad hoc networks with a realistic physical layer. *Journal of Parallel and Distributed Computing,* 66: 499–506, 2006.
3. Johnson Kuruvila, AmiyaNayak, and Ivan Stojmenovic. Progress and location based localized power aware routing for ad hoc and sensor wireless networks. *International Journal of Distributed Sensor Networks,* 2(2):147–159, July 2006.
4. Johnson Kuruvila, AmiyaNayak, and Ivan Stojmenovic. Hop count optimal position-based packet routing algorithms for ad hoc wireless networks with a realistic physical layer. *IEEE Journal on Selected Areas in Communications,* 23(6):1267–1275, 2005.
5. Douglas S. J. De Couto, Daniel Aguayo, John Bicket, and Robert Morris. A high-throughput path metric for multi-hop wireless routing. *Wireless Networks,* 11(4): 419–434, 2005.
6. Kemal Akkaya and Mohamed Younis. A survey on routing protocols for wireless sensor networks. *Ad hoc Networks,* 3(3): 325–349, May 2005.
7. KarimSeada, Marco Zuniga, Ahmed Helmy, and BhaskarKrishnamachari. Energy-efficient forwarding strategies for geographic routing in lossy wireless sensor networks. In *Proceedings of the 2nd International Conference on Embedded Networked Sensor Systems (SenSys'04),* pages 108–121, 2004.
8. Ivan Stojmenovic, AnandPrakashRuhil, and D. K. Lobiyal. Voronoi diagram and convex hull based geocasting and routing in wireless networks. In *Proceedings of the 8th IEEE Symposium on Computers and Communications ISCC,* pages 51–56, July 2003.
9. C. de MoraisCordeiro, H. Gossain, D. P. Agrawal, "Multicast over wireless mobile ad hoc networks: present and future directions," *IEEE Network,* Vol. 17, Issue: 1, January/February 2003.
10. A. Rao, S. Rathasamy, C. Papadimitriou, S. Shenker, and I. Stoica. Geographic routing without location information. In *Proceedings of the 9th Annual International Conference on Mobile Computing and Networking (MobiCom'03),* pages 96–108, 2003.
11. Marc Heissenb¨uttel and Torsten Braun. BLR: Beacon-less routing algorithm for mobile ad-hoc networks. *Elsevier's Computer Communications Journal,* pages 1076–1086, 2003.
12. Fabian Kuhn, Roger Wattenhofer, and Aaron Zollinger. Worst-case optimal and average-case efficient geometric ad-hoc routing. In *Proceedings of the 4th ACM International Symposium on Mobile Computing and Networking (MobiHoc 2003),* pages 267–278, 2003.
13. Fabian Kuhn, Roger Wattenhofer, Yan Zhang, and Aaron Zollinger. Geometric ad-hoc routing: Of theory and practice. In *Proceedings of the 22nd ACM International Symposium on the Principles of Distributed Computing (PODC)*, Boston, Massachusetts, USA, pages 63–72, July 2003.
14. Xu Lin and Ivan Stojmenovic. Location-based localized alternate, disjoint and multi-path routing algorithms for wireless networks. *Journal of Parallel and Distributed Computing,* 63:22–32, 2003.
15. M. Kwon and S. Fahmy, "Topology-Aware Overlay Networks for Group Communication," *Proc. ACM NOSSDAV'02,* Miami, FL, May, 2002.
16. Jie Wu, Fei Dai, Ming Gao, and Ivan Stojmenovic. On calculating power-aware connected dominating sets for efficient routing in ad hoc wireless networks. *Journal of Communications and Networks,* 4(1), March 2002.
17. Charles E. Perkins and PravinBhagwat. Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers. In Proceedings of the SIGCOMM '94 Conference on Communications Architectures, Protocols and Applications, pages 234–244, August 1994.
18. Radia Perlman. *Interconnections: Bridges and Routers*. Addison-Wesley, Reading, Massachusetts, 1992.
19. W. Xu and J. Rexford, *Miro: Multi-path Interdomain Routing*, Proc. ACM SIGCOMM, Aug. 2006.

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