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Research Article on Routing Protocols for MANET: A Review

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Abstract: Portable impromptu organizations are independently self-coordinated networks without any framework support. In a portable impromptu organization, hubs move for arbitrary reasons; accordingly the organization might encounter quick and unusual geography changes. Since hubs in a MANET ordinarily have restricted transmission goes, a few hubs can't convey straightforwardly with one another. Thus, directing ways in portable specially appointed networks possibly contain various jumps, and each hub in portable promotion has the obligation to go about as switch. This research article is a study of dynamic exploration directing conventions for MANET.

Keywords- Reactive Routing, Proactive Routing, Uni-casting Routing and Multicasting routing protocol.

I. INTRODUCTION: Dynamic exploration for MANET is continuing mostly in the area of Medium Access Control, directing, asset the board, power control, and security. In light of significance of directing conventions in unique multihoping networks, a great deal of MANET in directing conventions was proposed in the most recent years. Thinking about the unique properties of MANET, while contemplating any directing convention, by and large the following properties are normal, however these might not be feasible to fuse in a solitary arrangement.

- A directing convention for MANET ought to be conveyed in way to build its unwavering quality.
- A steering convention should planned consider unidirectional connections since remote medium may make a remote connection be opened in unidirectional as it were because of actual variables.
- The directing convention ought to be power-proficient.
- The steering convention ought to think about its security.
- A half and half steering convention should be considerably more responsive than proactive to stay away from upward.
- A steering convention ought to know about Quality of Administration (QoS).

A. Different types of Routing Protocols for MANET: Ad Hoc's directing conventions are ordered into two significant classifications:

- **Proactive Routing Protocols**: It ceaselessly gets familiar with the geography of the organization by trading topological data between organization hubs. In this way, when there is a need for a network to a destination, such network data is used right away. Although the organization geography changes too regularly, the charge of

keeping up with the organization are extremely high. When organization movement is low; the data with genuine geography could even not be utilized.

- **Responsive or Reactive Routing Protocols:** The receptive steering protocol depends on some kind of question answer discourse. Responsive protocol continues for laying out route(s) to the destination just when needed. Mixture Routing Protocols: responsive or proactive element of a specific routing convention probably won't be sufficient; a combination could be better arrangement. In view of the strategy for conveyance of information parcels from the source to objective, characterization of MANET directing conventions should be possible are:
- **Unicast Routing Protocols**: The directing protocol that think about transmitting stacks of info to different objective from different source.
- **Multicast Routing Protocols**: It is the conveyance of data to a collection of objections utilizing the productive methodology to send data packets of each connection of the organization just a single time, making copies, when the connections of the objections break. Multicasting directing conventions are characterized in two cases: Tree-based multicast convention and Network based multicast convention. Network based protocols uses a small network to arrive at an objective while the tree-based protocol keep up with just a single way.

II. PROPOSED PROACTIVE ROUTING PROTOCOLS

A. Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV): It is based on Bellman-Ford routing [2] algorithm for certain adjustments. In this steering protocol, every portable hub in organization keeps information through tables. Every node of directing table has the rundown of all suitable objections. Every table has an arrangement number, initiated by objective nodes. Occasional transfer of updates of steering tables help keeping up with the geography data of the network. Assuming, new critical change for the steering data and changes are communicated right away. In this way, the data updates could either be fixed or event driven. DSDV convention needs every versatile hub in the organization to promote directing table to current neighbouring nodes. The commercial is done by communicating or by multicasting. By the promotions, the adjoining nodes can be aware of changes that are there in the organization because of the developments of nodes.

B. Wireless Routing Protocol (WRP): It has a way of finding calculations [2,4,5], characterized as the arrangement of conveyed shortest path calculations that ascertain the ways utilizing data with respect to length and next to-last jump of the most limited way to each and every node. To defeat, every node it keep four things: 1. Distance table 2. Directing table 3. Connection cost table 4. Message retransmission list (MRL). The nodes in the reaction rundown of update message to send affirmations. Nodes can choose whether to update steering table subsequent to getting an update message from neighbouring node and consistently it searches for a superior way utilizing the latest data. Assuming a zone improves way, it transfers that data to the first node with the goal that they can refresh routing tables. Subsequent to the affirmation, the first node refreshes its MRL. Subsequently, the steering data is verified by every hub in this convention, which assists with disposing of directing circles and consistently attempts to find best route in the organization.

C. Cluster Gateway Switch Routing Protocol (CGSR): It thinks about a group of versatile remote organization rather than a "level" organization. For organizing the organization into separate however interrelated gatherings, bunch heads are chosen utilizing a bunch head choice calculation. By initiating a few groups, this protocol focused on a circulated handling component in the organization. In any case, it adjusts DSDV by utilizing a various leveled bunch head-to-door directing way to deal with course traffic from source to objective. A parcel transmit by a hub is first sent to its bunch head, and afterward the parcel is transmit from the group until the bunch top of the objective hub is reached.

D. Geographical State Routing (GSR): In this, nodes work on sections of connection between neighboring nodes during directing data trade. In connection state vectors, hubs keep

worldwide information on the organization geography and their routing habits. This protocol is like DSDV, yet it further develops DSDV as it maintains a strategic distance from flooding of steering messages.

E. Fisheye State Routing (FSR): It is based on GSR. The curiosity of FSR is that, it utilizes an extraordinary design of the organization called the "fisheye. 'This convention diminishes how much traffic for communicating the update messages. The main thought is that each update message doesn't contain data pretty much all hubs. All things considered, it contains update data about the closer hubs more as often as possible as that of the farther hubs. Thus, every hub can have precise and definite data about its own adjoining hubs.

F. Various leveled State Routing (HSR): HSR [9] consolidates dynamic, conveyed staggered progressive grouping strategy with an effective area the executives plot. This convention parcels the organization into a few bunches where each chosen group head in order to becomes individual from the following more elevated level. The fundamental thought is that, each bunch head sums up its own bunch data and engages it with adjoining group heads utilizing doors. Subsequent to running the calculation, hub can flood the data to its next level hubs. The various leveled network utilized in the convention is sufficiently proficient to convey information effectively to piece of the network.

G. Zone-Based Hierarchical Link State Routing Protocol (ZHLS): In this organization is partitioned into non overlapping zones. Every hub has the information about node availability inside the network and the network availability in the whole organization. The connection is utilized by two parts: hub level and worldwide zone level. Since just zone ID and hub ID of an objective are required for directing, course from a source to an objective is versatile to evolving geography. The objective of zone id is detected by transmitting one area solicitation to each hub.

H. Milestone Ad Hoc Routing (LANMAR): It consolidates elements of Fisheye State Directing (FSR) and Landmark Routing [11]. It utilizes the idea of milestone from Landmark Routing and initially created for fixed region organizations. A milestone is characterized as a switch whose neighboring switches inside a specific number of jumps contain directing sections for particular switch. Utilizing this idea for the hubs in it, LANMAR separates the organization into a few pre-characterized consistent subnets, with a preselected milestone. All nodes are accepted to move collectively. The courses to the milestones, and consequently the comparing subnets, are proactively kept up with all hubs in the organization through the trading of distance vectors. LANMAR could be viewed as an expansion of FSR, with bunch versatility by summing up the courses to the bunch individuals with a solitary course to a milestone.

I. Upgraded Link State Routing (OLSR): This convention acquires the strength of connection state calculation. This convention performs bounce by-jump steering; that, every hub in the organization utilizes its latest data to highway a parcel. Subsequently, in any event, when a hub is in motion, its parcel can be conveyed to it, assuming its speed is with the end goal that its developments will be continued in own area. The streamlining in steering is done principally in different patterns. Initially, OLSR lessens the size of the control parcels for a specific hub by proclaiming just a subset of connections with hub's neighboring nodes who are its multipoint transfer paths, rather than all joined in the organization. As just multipoint transfers of hub can transfer its transmission messages.

III. PROPOSED REACTIVE ROUTING PROTOCOLS

A. Associative-Based Routing (ABR): ABR convention characterizes another sort of directing measurement "level of affiliation steadiness" for portable impromptu organizations. In this steering protocol, a network is selected in light of the level of affiliation strength of portable nodes. Every hub produces guide to convey its presence. After getting message, a neighbor hub refreshes its associative table. A high

worth of associative point for a particular beaconing hub implies that the hub is moderately static. Associative point is reset while any adjoining hub moves out of the neighborhood of some other node.

B. Signal Stability–Based Adaptive Routing Protocol (SSA): These Convention Centers on getting the steadiest courses by a specially appointed network. The convention performs on request course revelation in light of sign strength and area security. In light of the sign strength, SSA distinguishes powerless and solid directs in the organization. SSA is categorized into two helpful conventions: the Dynamic Routing Protocol (DRP) and the Static Routing Protocol (SRP). SRP passes the parcel to hub's upper layer stack assuming it is the objective. In any case, it searches for the objective in directing table and advances the parcel. Assuming there is no access in the steering table for that objective, it starts the course tracking down process. Course demand parcels are sent to the neighbors utilizing the solid channels. The objective, in the wake of getting the solicitation, picks the first showing up demand bundle and sends back the answer. The source thusly sends a delete message to illuminate all hubs about the wrecked connection and starts another course search cycle to track down another way to objective.

C. Temporarily Ordered Routing Algorithm (TORA): It is a reactive steering protocol for certain proactive improvements where a connection between nodes is laid out. It uses an "interface inversion" model in network revelation. A network submission question is communicated and spread all through the organization until it arrives at the objective or a hub that has a data to arrive at the objective. TORA defines a boundary, named tallness. Tallness is a proportion of the distance of the answering node’s distance up to the necessary objective hub. The source hub, at that point, utilizes the stature to choose the best network toward the objective. This convention has a different property that it much of the time picks the most helpful course, instead of the choicest course. For this large number of endeavors, TORA attempts to limit the directing administration traffic upward.

D. Cluster-Based Routing Protocol (CBRP): It is an on-request directing convention and are separated in bunches. When hub enters in the organization, it has the unsure state. The principal undertaking of this hub is to start a clock and to convey a HELLO message. At the point when a packet gets this HELLO message, it answers rapidly with a set off HELLO message. From there on out, at whatever point the center gets this reaction, it altogether affects its condition into the part condition. Regardless, when center node gets no message from any bundle head, it makes itself as a gathering head. Each center has a neighbor table. For each neighbor, the center keeps what is going on with the association and situation of the neighbor in the neighbor table. A cluster head keeps information essentially every one of its people in a comparable gathering, which gives information about abutting gatherings.

E. Dynamic Source Routing (DSR): It permits nodes in the ad hoc network to find a source node across numerous organizations reflects to any objective. In this protocol, the dynamic nodes are expected to increase with node reserves or the known nodes. Directing in DSR includes two stages i.e. node revelation and node support. When a source hub needs to send a data to destination, it initially relates its course store to decide that it definitely is familiar with any course to the objective or not. This solicitation incorporates the objective location, source address, and an exceptional recognizable proof number. Each middle of the road hub checks whether it knows about the objective or not. In the event that the transitional hub doesn't have any familiarity with the objective, it again advances the parcel and in the long run this arrives at the objective. A hub processes the course demand bundle provided that it has not recently handled the parcel and its location is absent in the course record of the parcel.

F. Specially appointed On-Demand Distance Vector Routing (AODV): It is fundamentally advancement over DSDV. Yet, it is a responsive directing convention rather than proactive one. It limits the quantity of transmissions by making courses based on request. When a source hub needs to transmit data to an objective, it communicates a data demand (RREQ) parcel. The adjoining nodes thusly broadcast the parcel to their neighbors and the cycles go on until the parcel arrives at the objective. During the interaction of sending the course demand, middle hubs record the location of the neighbor by which the primary duplicate of the transmission parcel is changed. Recorded one will put away in their course tables, which helps for laying out a converse way. In event that extra duplicates of a similar RREQ are subsequently chosen, these parcels are disposed of. For network support, when a source hub moves, it can restart a course disclosure activity. This interaction proceeds until the disappointment warning arrives at the source hub. In light of the got data, the source chooses to start again the course disclosure stage.

IV. PROPOSED HYBRID ROUTING PROTOCOLS:

A. Double Hybrid Adaptive Routing (DHAR): It utilizes the Distributed Dynamic Cluster Calculation. The possibility of DDCA is progressively segment the organization into non-covering bunches of hubs comprising of one parent and at least no kids. Directing is done using two level various leveled procedure, comprising of ideal and least overhead table-driven calculations. DHAR executes a proactive least-upward level-2 directing convention in blend with a powerful restricting convention to accomplish its crossover qualities. The convention in DHAR expects that a single hub creates a report for its group. At the point when any update is created, it should be overwhelmed to every one of the hubs in each adjoining bunch. Level-2 refreshes were not communicated past the adjoining groups.

The hub with the most minimal hub ID in each group is assigned to produce level-2 updates. The limiting system is like a responsive course disclosure process; in any case, deduced information of grouped geography makes it fundamentally more productive and easier to achieve the steering. To send bundles to the wanted objective, a source hub utilizes the powerful restricting convention to find the current bunch ID related with the objective. Not entirely set in stone, this data is kept up with in the powerful bunch restricting reserve at the source hub. The dynamic restricting convention uses the information fair and square geography to effectively communicate a limiting solicitation to all the groups. This is accomplished utilizing reverse way sending with regard to the source group.

B. Versatile Distance Vector Routing (ADV): This directing convention is a distance-vector steering calculation that displays on-request includes by editing the chances and the size of steering refreshes because of network burden and versatility patterns. ADV uses a versatile instrument to alleviate the impact of intermittent sending of the steering refreshes, which essentially depends on the organization load what's more, portability conditions. To diminish the directing updates, ADV publicizes and keeps up with courses for the dynamic collectors as it were. A hub is viewed as dynamic assuming it is the collector of any presently dynamic association. To transmit information, a source hub communicates network-wide an init-association control bundle. Wide range of various hubs turns on the comparing collector banner with steering tables and begins publicizing the courses to beneficiary in ongoing details. Whenever objective hub gets in it-association bundle, it answers it by communicating a collector ready parcel and becomes dynamic. To end an association, the source hub communicates network-wide association control parcel, showing that the association is to be end. Assuming that objective hub has no extra dynamic association, it communicates a non-recipient ready message. ADV additionally characterizes a few different boundaries like trigger meter, trigger edge, and support edge. These are utilized for restricting the organization traffic in light of the organization's versatility example and organization speed.

C. Zone Routing Protocol (ZRP): It is reasonable for huge assortment for ad hoc networking, particularly for organizations with enormous range and changing

versatility designs. In this convention, every node proactively keeps the courses inside a neighborhood locale, which is named as directing zone. Making various hubs in the organization, a hub needs to realize who its neighbors are. A neighboring node is characterized as that zone where direct correspondence can be laid out, what's more, or at least, inside one jump transmission scope of a node. Neighbor's data is used as a reason for Intra-zone Routing Protocol (IARP). As opposed to blinding telecom, ZRP utilizes an inquiry control component to diminish course question traffic by coordinating inquiry messages from the question source and away from covered directing areas. A covered hub is that thing which has a place to the steering zone of a hub that has gotten a course question. During the sending of the question parcel, a hub finds it regardless of whether it is coming from neighbor. The question in this manner transferred till it arrives at the objective. The objective thusly retransmits an answer message through the switch way and makes the course.

D. Sharp Hybrid Adaptive Routing Protocol (SHARP): It adjusts among reactive and proactive directing by progressively changing how much steering data shared proactively. This convention characterizes the proactive zones around certain hubs. The quantity of hubs in a specific proactive zone is not entirely settled by the hub explicit zone range. Proactive steering is consumed inside the proactive zone only. In this protocol, proactive zones are naturally assuming little objections are much of the time tended to or looked for inside the organization. The proactive nodes are gatherers of parcels, which passes the bundles effectively to the objective, when the parcels arrive at the network area.

E. Neighbor-Aware Multicast Routing Protocol (NAMP): It is a tree-based cross breed steering convention, which uses neighborhood data. The courses in the organization are constructed and kept up with utilizing the conventional solicitation and answer messages or on-request premise. This half breed convention utilizes neighbor data of two-jumps away for sending the parcels to the recipient. On the next level the recipient is not inside this reach, it look through the collector utilizing prevailing flooding strategy [25] that structures a multicast tree utilizing the answers with turnaround way. Albeit the cross section pattern is more vigorous with topological changes, the tree structure works well as bundle transmission. As this protocol focuses to accomplish less start to finish deferral of bundles, it utilizes the tree structure. It generally uses three activities tended to in NAMP: Multicast tree creation, Multicast tree support and Joining and leaving of hubs. Every one of the hubs in the organization keeps neighborhood data of up to two-bounce away hubs. This local data is kept up with utilizing a proactive instrument. To make the multicast tree, source hub sends the request in bulk, to the objective with information payload joined. The packet is overflowed in the organization utilizing prevailing strategy that all things considered limits the quantity of transmissions in the organization for a specific flood demand bundle. During the sending cycle of the bundle, every hub chooses a forwarder and makes an optional forwarder list. The auxiliary forwarder list have the data about hubs that were principally considered conceivable forwarders yet at last were not chose for that reason. Optional forwarder list is used for fixing any messed up course in the zone. As interface disappointment recuperation is the best benefits of NAMP.

V. DIFFERENT ROUTING PROTOCOLS

Notwithstanding the referenced steering conventions for ad hoc networks, there are many conventions that don't depend on conventional steering instruments, rather depend on the area familiarity with the taking an interest hubs in the organization. By and large, in customary

MANETs, the hubs are tended to just with their IP addresses. Yet, if there should be an occurrence of area mindful directing instruments, the hubs are regularly mindful of precise physical areas. The capacity may be presented in the hubs utilizing Global Positioning System (GPS) or some other mathematical techniques. In view of these ideas, a few geocast and area mindful steering conventions have as of now been proposed. The significant component of these directing conventions is that, when a hub is familiar with the area of a specific objective, it can coordinate the parcels toward that specific bearing from its present position, without utilizing any course revelation system. As of late, a portion of the scientists proposed some area mindful conventions that depend on these kinds of thought. There are various multicast steering conventions for MANET. A portion of the multicast steering conventions are: Location-Based Multicast Protocol (LBM)[31], Multicast Core Extraction Distributed Ad hoc Steering (MCEDAR)[32], Ad hoc Multicast Routing convention using Increasing id-numbers (AMRIS)[33], Associatively- Based Ad hoc Multicast (ABAM)[34], Multicast Ad hoc On-Request Distance-Vector (MAODV) steering [35],Differential Objective Multicast (DDM)[36],On-Demand Multicast Steering Protocol (ODMRP)[37], Adaptive Demand-driven Multicast Routing (ADMR) convention [38], Ad hoc Multicast Steering convention (AM Route)[39], Dynamic Core-based Multicast steering Protocol (DCMP)[40], Preferred Link-Based Multicast convention (PLBM)[41],etc. A portion of these conventions use area data and some depend on other steering conventions or grew similarly as the augmentation of another unicast directing convention.

VI. RECENT WORK DONE

It specifies a rundown of previous work for the new deals with directing in MANET so it very well may be utilized as a reference by the specialists. A portion of the previous research work inspired directing conventions as their base and some of them have improved different exhibitions of the past directing conventions. Some of the late works are: hub thickness based directing [42], load-adjusted steering [43], improved priority based energy-productive directing [44], solid on-request steering with versatility forecast [45], QoS directing [46], secure disseminated unknown directing convention [47], hearty position based steering [48], directing with bunch movement support [49], thick group door based directing convention [50], dynamic reinforcement courses directing convention [51], gathering-based steering convention [52], QoS-mindful multicast directing convention [53], reused way directing [54], QoS multicast steering convention for grouping in ad hoc networks [55], secure unknown directing convention with confirmed key trade [56], self-recuperating on-request geographic way directing convention, stable weight-based on demand steering convention, fisheye zone directing convention , on-request utility-based power control steering, secure position-based steering convention, versatile multi-way on-request steering, virtual direction based steering , and so forth.

VII. CONCLUSION

This article generally deals with the important routing features of MANET i.e. proactive and reactive. Proactive directing conventions will quite often give lower inactivity than that of the on-request conventions, since they attempt to keep up with courses to every one of the hubs in the organization constantly. Yet, the downside for such conventions is the inordinate steering upward communicated, which is intermittent in nature without much thought for the organization versatility or burden. On the other hand, however responsive conventions find courses just when they are required, they might in any case produce an immense measure of traffic whenever the organization changes much of the time. Contingent upon the measure of organization load and quantity of streams, directing conventions could be picked. Whenever blockage is there due to weighty traffic, in everyday case, a receptive convention is ideal. Network versatility is one more element that can debase the exhibition of certain conventions. At the point when the organization is generally static, proactive steering conventions can be utilized, as putting away the geography data in such case is more effective. Then again, as the portability of hubs in the organization increments, responsive conventions perform better. In

general, the response to discussing this point may be portability and traffic example of the zone should assume the vital part for picking a fitting steering procedure for a specific organization. It is very regular that one specific arrangement can't be applied for a wide range of circumstances and, regardless of whether applied, probably won't be ideal taking all things together cases. Regularly it is more fitting to apply a half and half convention rather than a rigorously proactive or receptive convention as half breed conventions regularly have the benefits of the two kinds of conventions.

VIII. SCOPE FOR FUTURE RESEARCH

Increasingly more productive steering conventions for ad hoc networks will come in the approaching future due to security and Quality of Service as the central issues.

Up to this point, the steering conventions predominantly centered on the strategies for directing, however in future a got yet QoS-mindful steering convention could be chipped away at. Guaranteeing both of these boundaries at the same time may be troublesome. An exceptionally protected steering convention certainly brings about more upward for directing, which could debase the QoS factor. Although in previous research some multicast steering conventions were already proposed. Justification behind the developing significance of multicast is that to utilize it as a way to decrease data transfer capacity usage for mass conveyance of information. As there is a squeezing need to moderate scant data transfer capacity over remote media, it is normal that multicast directing ought to get some consideration for specially appointed zones. So it's in vast majority of the cases, beneficial to utilize multicast rather than various unicast, particularly in specially appointed climate where data transfer capacity comes at a higher cost than normal. Impromptu remote organizations track down applications in regular citizen tasks (cooperative and circulated figuring) crisis search and- salvage, regulation implementation, and fighting circumstances, where setting up and keeping a correspondence framework is undeniably challenging. In this large number of utilizations, correspondence and coordination among a given arrangement of hubs are fundamental. Taking into account every one of these, in future the directing conventions may particularly stress the help for multicasting in the ad hoc network.

REFERENCES

[1] Perkins CE, Bhagwat P (1994) Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers. Proceedings of ACM SIGCOMM 1994:234–244.

[2] Cheng C, Riley R, Kumar SPR, Garcia-Luna-Aceves JJ (1989) A Loop- Free Extended Bellman-Ford Routing Protocol Without Bouncing Effect. ACM SIGCOMM Computer Communications Review, Volume 19, Issue 4:224–236.

[3] Murthy S, Garcia-Luna-Aceves JJ (1996) An Efficient Routing Protocol for Wireless Networks. Mobile Networks and Applications, Volume 1, Issue 2:183–197[4] Humblet PA (1991) Another Adaptive Distributed Shortest-Path Algorithm. IEEE Transactions on Communications, Volume 39, Issue 6:995–1003.

[5] Rajagopalan B, Faiman M (1991) A Responsive Distributed Shortest- Path Routing Algorithm Within Autonomous Systems. Journal of Internetworking Research and Experiment, Volume 2, Issue 1:51–69.

[6] Chiang C-C, Wu H-K, Liu W, Gerla M (1997) Routing in Clustered Multihop, Mobile Wireless Networks with Fading Channel. Proceedings of IEEE SICON:197–211.

[7] Chen T-W, Gerla M (1998) Global State Routing: A New Routing Scheme for Ad-hoc Wireless Networks. Proceedings of IEEE ICC 1998:171–175.

[8] Iwata A, Chiang C-C, Pei G, Gerla M, Chen T-W (1999) Scalable Routing Strategies for Ad Hoc Wireless Networks. IEEE Journal on Selected Areas in Communications, Volume 17, Issue 8:1369–1379.

[9] Jao-Ng M, Lu I-T (1999) A Peer-to-Peer Zone-Based Two-Level Link State Routing for Mobile Ad Hoc Networks. IEEE Journal on Selected Areas in Communications, Volume 17, Issue 8:1415–1425.

[10] Pei G, Gerla M, Hong X (2000) LANMAR: Landmark Routing for Large Scale Wireless Ad Hoc Network with Group Mobility. First Annual Workshop on Mobile and Ad Hoc Networking and Computing 2000 (MobiHoc 2000):11–18
[11] Tsuchiya PF (1988) The Landmark Hierarchy: A New Hierarchy for Routing in Very Large Networks. Computer Communication Review, Volume 18, Issue 4:35–42.
[12] Jacquet P, Mu¨ hlethaler P, Clausen T, Laouiti A, Qayyum A, Viennot L (2001) Optimized Link State Routing Protocol for Ad Hoc Networks. IEEE INMIC 2001:62–68.
[13] Toh C-K (1996) A Novel Distributed Routing Protocol to Support Ad- Hoc Mobile Computing. Proceedings of the 1996 IEEE 15th Annual International Phoenix Conference on Computers and Communications:480–486.
[14] Dube R, Rais CD, Wang K-Y, Tripathi SK (1997) Signal Stability- Based Adaptive Routing (SSA) for Ad Hoc Mobile Networks. IEEE Personal Communications, Volume 4, Issue 1:36–45
[15] Park VD, Corson MS (1997) A highly adaptive distributed routing algorithm for mobile wireless networks. Proceedings of IEEE INFOCOM 1997, Volume 3:1405–1413.
[16] Jiang M, Li J, Tay YC (1999) Cluster Based Routing Protocol (CBRP). IETF Draft, August 1999, available at http://tools.ietf.org/html/draftietf- manet-cbrp-spec-01. Accessed 21 February 2008
[17] Broch J, Johnson DB, Maltz DA (1999) The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks. IETF Draft, October, 1999, available at http://tools.ietf.org/id/draft-ietf-manet-dsr-03.txt. Accessed 21 February 2008.
[18] Perkins CE, Royer EM, Chakeres ID (2003) Ad hoc On-Demand Distance Vector (AODV) Routing. IETF Draft, October, 2003, available at http://tools.ietf.org/html/draft-perkins-manet-aodvbis-00. Accessed 21 February 2008.
[19] McDonald AB, Znati T (2000) A Dual-Hybrid Adaptive Routing Strategy for Wireless Ad-Hoc Networks. Proceedings of IEEE WCNC 2000, Volume 3:1125–1130 26. McDonald AB, Znati T (1999) A Mobility Based Framework for Adaptive Clustering in Wireless Ad-Hoc Networks. IEEE Journal on Selected Areas in Communications, Special Issue on Ad-Hoc Networks, Volume 17, Issue 8:1466–1487.
[20] Boppana RV, Konduru SP (2001) An Adaptive Distance Vector Routing Algorithm for Mobile, Ad Hoc Networks. Proceedings of IEEE INFOCOM 2001:1753–1762
[21] Haas ZJ, Pearlman MR, Samar P (2002) The Zone Routing Protocol (ZRP) for Ad Hoc Networks. IETF draft, July 2002, available at http://tools.ietf.org/id/draft-ietf-manetzone-zrp-04.txt. Accessed 21 February 2008 94 A.-S.K. Pathan and C.S. Hong.
[22] Haas ZJ, Pearlman MR, Samar P (2002) Intrazone Routing Protocol (IARP). IETF Internet Draft, July 2002, available at http://tools.ietf.org/wg/manet/draft-ietf-manetzone-ierp/draft-ietf-manetzone-ierp-02-from-01.diff.txt. Accessed 21 February 2008.
[23] Ramasubramanian V, Haas ZJ, Sirer, EG (2003) SHARP: A Hybrid Adaptive Routing Protocol for Mobile Ad Hoc Networks. Proceedings of ACM MobiHoc 2003:303–314.
[24] Pathan A-SK, Alam MM, Monowar MM, Rabbi MF (2004) An Efficient Routing Protocol for Mobile Ad Hoc Networks with Neighbor Awareness and Multicasting. Proceedings of IEEE E-Tech, July, 2004:97–100.
[25] Lim H, Kim C (2000) Multicast Tree Construction and Flooding in Wireless Ad Hoc Networks. Proceedings of the 3rd ACM International Workshop on Modeling, Analysis and Simulation of Wireless and Mobile Systems:61–68.
[26] Lin X, Stojmenovic I (1999) GEDIR: Loop-Free Location Based Routing in Wireless Networks. Proceedings of the IASTED International Conference on Parallel and Distributed Computing and Systems:1025– 1028.
[27] Ko Y-B, Vaidya NH (2000) Location-Aided Routing (LAR) in Mobile Ad Hoc Networks. Wireless Networks, Volume 6:307–321.
[28] Karp B, Kung HT (2000) GPSR: Greedy Perimeter Stateless Routing for Wireless Networks. ACM MOBICOM 2000:243–254.
[29] Liao W-H, Tseng Y-C, Lo K-L, Sheu J-P (2000) GeoGRID: A Geocasting Protocol for Mobile Ad Hoc Networks based on GRID. Journal of Internet Technology, Volume 1, Issue 2:23–32
[30] Jain R, Puri A, Sengupta R (2001) Geographical Routing Using Partial Information for Wireless Ad Hoc Networks. IEEE Personal Communications, Volume 8, Issue 1:48–57.

[31] Ko Y-B, Vaidya NH (1998) Location-based multicast in mobile ad hoc networks. Technical Report TR98-018, Texas A&M University
[32] Sinha P, Sivakumar R, Bharghavan V (1999) MCEDAR: Multicast Core-Extraction Distributed Ad Hoc Routing. Proceedings of IEEE WCNC, Volume 3:1313–1317
[33] Wu CW, Tay TC (1999) AMRIS: A Multicast Protocol for Ad Hoc Wireless Networks. IEEE MILCOM 1999, Volume 1:25–29
[34] Toh C-K, Guichal G, Bunchua S (2000) ABAM: On-Demand Associativity-Based Multicast Routing for Ad Hoc Mobile Networks. Proceedings of IEEE VTS-Fall VTC 2000, Volume 3:987–993
[35] Royer EM, Perkins CE (2000) Multicast Ad Hoc On-Demand Distance Vector (MAODV) Routing. IETF Draft, draft-ietf-manet-maodv-00, 15 July, 2000, available at http://tools.ietf.org/html/draft-ietf-manet-maodv- 00. Accessed 21 February 2008
[36] Ji L, Corson MS (2001) Differential DestinationMulticast-A MANETMulticast Routing Protocol for Small Groups. Proceedings of IEEE INFOCOM 2001, Volume 2:1192–1201
[37] Lee S, Su W, Gerla M (2002) On-Demand Multicast Routing Protocol in Multihop Wireless Mobile Networks. ACM/Kluwer Mobile Networks and Applications (MONET), volume 7, Issue 6:441–453
[38] Jetcheva JG, Johnson DB (2001) Adaptive Demand-Driven Multicast Routing in Multi-Hop Wireless Ad Hoc Networks. Proceedings of ACM MobiHoc 2001:33–44
[39] Xie J, Talpade RR, Mcauley A, Liu M (2002) AMRoute: Ad Hoc Multicast Routing Protocol. Mobile Networks and Applications, Volume 7, Issue 6:429–439
[40] Das SK, Manoj BS, Murthy CSR (2002) A Dynamic Core Based Multicast Routing Protocol for Ad Hoc Wireless Networks. Proceedings of ACM MobiHoc 2002:24–35.
[41] Sisodia RS, Karthigeyan I, Manoj BS, Murthy CSR (2003) A Preferred Link Based Multicast Protocol for Wireless Mobile Ad Hoc Networks. Proceedings of IEEE ICC 2003, Volume 3:2213–2217.
[42] Quintero A, Pierre S, Macabe´o B (2004) A routing protocol based on node density for ad hoc networks. Ad Hoc Networks, Volume 2, Issue 3:335–349
[43] Saigal V, Nayak AK, Pradhan SK, MallR(2004) Load balanced routing in mobile ad hoc networks. Computer Communications, Volume 27, Issue 3:295–3054 Routing in Mobile Ad Hoc Networks 95.
[44] Wei X, Chen G, Wan Y, Mtenzi F (2004) Optimized priority based energy efficient routing algorithm for mobile ad hoc networks. Ad Hoc Networks, Volume 2, Issue 3:231–239
[45] Wang N-C, Chang S-W (2005) A reliable on-demand routing protocol for mobile ad hoc networks with mobility prediction. Computer Communications, Volume 29, Issue 1:123–135
[46] Bu¨ r K, Ersoy C (2005) Ad hoc quality of service multicast routing. Computer Communications, Volume 29, Issue 1:136–148
[47] Boukerche A, El-Khatib K, Xu L, Korba L (2005) An efficient secure distributed anonymous routing protocol for mobile and wireless ad hoc networks. Computer Communications, Volume 28, Issue 10:1193–1203.
[48] Moaveninejad K, Song W-Z, Li X-Y (2005) Robust position-based routing for wireless ad hoc networks. Ad Hoc Networks, Volume 3, Issue 5:546–559.
[49] Rango FD, Gerla M, Marano S (2006) A scalable routing scheme with group motion support in large and dense wireless ad hoc networks. Computers&Electrical Engineering, Volume 32, Issues 1–3:224–240.
[50] Ghosh RK, Garg V, Meitei MS, Raman S, Kumar A, Tewari N (2006) Dense cluster gateway based routing protocol for multi-hop mobile ad hoc networks. Ad Hoc Networks, Volume 4, Issue 2:168–185.
[51] Wang Y-H, Chao C-F (2006) Dynamic backup routes routing protocol for mobile ad hoc networks. Information Sciences, Volume 176, Issue 2:161–185.
[52] Ahn CW (2006) Gathering-based routing protocol in mobile ad hoc networks. Computer Communications, Volume 30, Issue 1:202–206.
[53] Sun B, Li L (2006) QoS-aware multicast routing protocol for Ad hoc networks. Journal of Systems Engineering and Electronics, Volume 17, Issue 2:417–422.

[54] Eisbrener J, Murphy G, Eade D, Pinnow CK, Begum K, Park S, Yoo SM, Youn J-H (2006) Recycled path routing in mobile ad hoc networks. Computer Communications, Volume 29, Issue 9:1552–1560.
[55] Layuan L, Chunlin L (2007) A QoS multicast routing protocol for clustering mobile ad hoc networks. Computer Communications, Volume 30, Issue 7:1641–1654.
[56] Lu R, Cao Z, Wang L, Sun C (2007) A secure anonymous routing protocol with authenticated key exchange for ad hoc networks. Computer Standards & Interfaces, Volume 29, Issue 5:521–527.
[57] Giruka VC, Singhal M (2007) A self-healing On-demand Geographic Path Routing Protocol for mobile ad-hoc networks. Ad Hoc Networks, Volume 5, Issue 7:1113–1128.
[58] Wang N-C, Huang Y-F, Chen J-C (2007) A stable weight-based ondemand routing protocol for mobile ad hoc networks. Information Sciences: an International Journal, Volume 177, Issue 24:5522–5537.
[59] Yang C-C, Tseng L-P (2007) Fisheye zone routing protocol: A multilevel zone routing protocol for mobile ad hoc networks. Computer Communications, Volume 30, Issue 2:261–268.
[60] Min C-H, Kim S (2007) On-demand utility-based power control routing for energy-aware optimization in mobile ad hoc networks. Journal of Network and Computer Applications, Volume 30, Issue 2:706–727.
[61] Song J-H, Wong VWS, Leung VCM (2007) Secure position-based routing protocol for mobile ad hoc networks. Ad Hoc Networks, Volume 5, Issue 1:76–86.
[62] Reddy LR, Raghavan SV (2007) SMORT: Scalable multipath ondemand routing for mobile ad hoc networks. Ad Hoc Networks, Volume 5, Issue 2:162–188.
[63] Zhao Y, Chen Y, Li B, Zhang Q (2007) Hop ID: A Virtual Coordinate- Based Routing for Sparse Mobile Ad Hoc Networks. IEEE Transactions on Mobile Computing, Volume 6, Issue 9:1075–1089.