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COMPARATIVE ANALYSIS OF CLUSTERING BASED ROUTING PROTOCOLS IN MOBILE ADHOC NETWORK (MANET)

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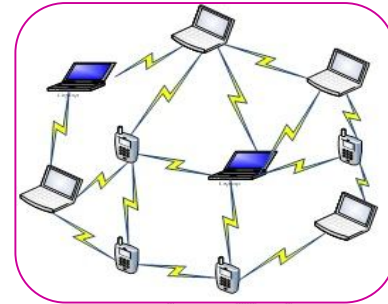
ABSTRACT

As network will always be required for nodes to communicate, so these nodes are taking help of some type of medium that may be wired or wireless medium, depending upon the type of resources available with that network. MANET is a type of network that is infrastructure less network. It means that it does not require any specific infrastructure at the time of network establishment. As MANET is infrastructure less network so it is finding its applications in multiple areas like military, commercial, etc. But for communication, nodes need to be synchronized with each other for data transfer. This data transfer is only possible through routing protocols that may help nodes to communicate with each other either by submitting their request in advance or on demand at the time of usage only. MANET usually support three categories of communication protocols and these are reactive, proactive & hybrid. In this paper, clustering based routing protocols are discussed for establishing communication among nodes for the purpose of making this process easier and reliable. A number of such protocols exist with such nature and can be selected as well as used in some cluster formation process.

KEYWORDS: : *MANET, Cluster, Cluster Head Selection, Hierarchical Cluster Routing Protocol (HCRP), AODV, MAODV, AOMDV, EVSM, WCA.*

INTRODUCTION

Mobile Adhoc Network (MANET) is a self-configurable network as it does not require any pre-assembled infrastructure. MANET completely work in environment in which infrastructure will assembled at the time of usage. For this reason, it is called as Adhoc network or temporary network. Devices will only configure infrastructure for that duration for which communication is required, after that, infrastructure is not mandatorily required to be part of same temporary network. The same infrastructure may become part of any other adhoc network now. This main feature of MANET makes it so much important in many applications. Generally the resource reservation happens for a long time and the resource remains in idle state for long time that may become a problem for the other nodes, who are in need of these resources. Therefore, researchers are also doing work on it. Earlier, nodes may communicate with each other and have to follow the steps defined by the Protocol. Depending upon networks and device's nature or requirement, different protocols are available and may be selected for data transfer from source to destination. Reactive Protocols are in which path is usually established at real time. In Proactive protocols, for each node there exist a predefined routing table. Hybrid protocol category is combination of proactive and reactive protocol categories. As an individual node may behave like a host as well as router, so MANET offers its services in various applications like disaster relief, mobile office, etc. As node connectivity may differ from time to time due to node movement, that means network topology of MANET is dynamic, therefore an effective routing

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protocol is always in demand. All nodes involved in MANET are free to move anywhere and anytime that justify its dynamic and infrastructure less behavior of nodes and MANET [1].
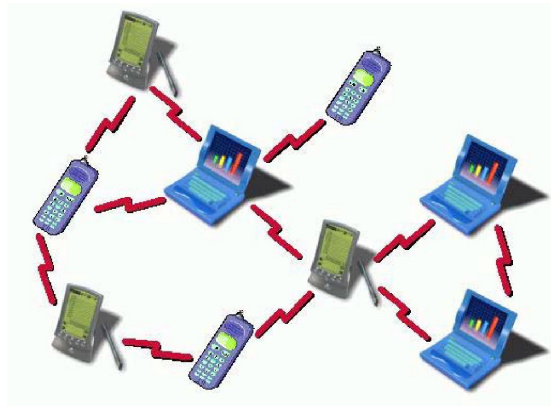

Figure 1. Mobile Ad-hoc Networks [4]

RELATED WORK:

In paper, Modified AODV routing protocol [1] was offered as solution to one of the problem of AODV routing protocol that is AODV, a reactive protocol, in which route detection and mechanism never worry about loss of route reply (RREP) messages at time of data communication that actually leads to lower down system efficiency [2]. In paper [3], work was done to maintain record of all possible paths between source and destination so that any problem related to failure of actual route can be avoided by bypassing it and transferring data through any of other alternate node. But definitely, this process may consume more energy and require some more capacity to keep record of alternate paths. Different phases like Route Request (RREQ), as shown in Figure 2, and Route Reply (RREP), as shown in Figure 3, were designed as part of MANET routing. Maintaining this data, mostly, help at the time of receiving Route Reply (RREP). Because, if any node is not working during RREQ phase then obviously that node will not receive any RREQ signal as well as not capable to participate in RREP process for whole communication of data. Therefore, it will maintain data of only those nodes that participate at time of RREQ phase. MAODV routing protocol was further evaluated with Random Walk, Random Waypoint, Random Direction, Gauss-Markov mobility models with End to End delay, Average Hop Count and Throughput as measurement parameters. [1]
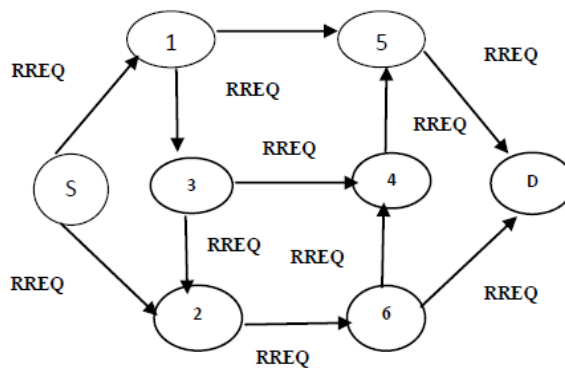

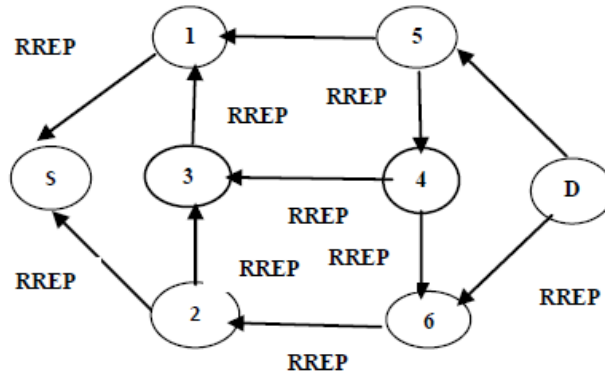Figure 2. Route Discovery phase in MAODV [1]

Figure 3. Reverse Path in MAODV [1]

In another paper [4], researchers thought about video streaming in MANET with its routing protocols. As in today's world, data may take any form so MANET routing protocols must also be capable to transfer that same data without compromising with any content value. For this, in particular Ad-hoc On-request Distance Vector (AODV), as shown in Figure 4, Ad-hoc On-request Multipath Distance Vector (AOMDV), as shown in Figure 5, Enhanced Video Streaming in MANET (EVSM) were considered and analyzed on metrics of throughput, normal network delay and packet delivery ratio. This paper again focuses on selection of route so that packet delivery ratio can be increased to high. For the same, the help of Route Error (RERR) messages are also taken.
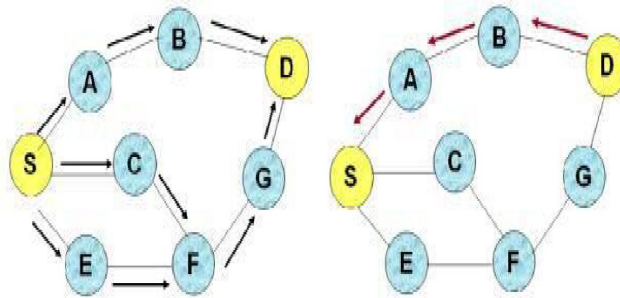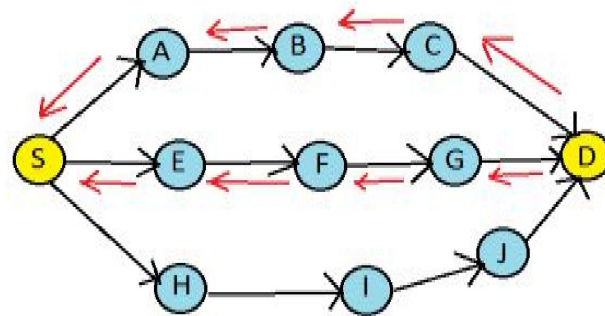

Figure 4. AODV Route Discovery [4]

Figure 5. Routing Node of S in AOMDV [4]

Among these routing protocols for video streaming, Enhanced Video Streaming in MANET (EVSM) was considered as better in comparison to other routing protocols. No doubt, routing overhead has increased tremendously in EVSM, but this makes throughput constant as well as more reliable. All this was

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made possible when selection among multiple paths become part of consideration. But, this process makes our system more vulnerable to security.

In Paper [5], Clustering technique is thought of to minimize the workload and to increase throughput in some way. Actually, in this technique, the network in earlier situation was considered as one, now will start considered as multiple, because, actually it is now managed in clusters. Due to this reason, this paper, includes Cluster head and task starts with identification of nodes because it considers Ordinary nodes as well as Cluster Gateway nodes along with Cluster head too. Cluster Head will be responsible for its set of nodes. Cluster head has to take charge of nodes in its cluster because it may use for routing too. Almost similar to routing feature of Cluster head, Cluster Gateway nodes also need to take responsibility for routing between clusters, as it lies within range of transmission of two or more cluster heads. All other nodes are not given any specific function to perform in cluster. These nodes are only considered as members of cluster, as shown in figure 6.
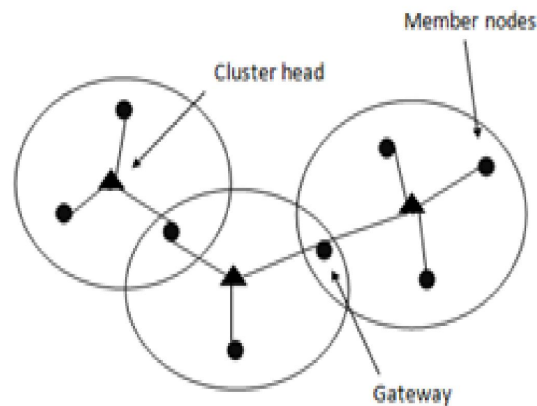

Figure 6. Cluster structure [5]

There is no shortage of clustering-based routing algorithm, but the challenge is to select an efficient routing protocol that can support such clustering scheme too. A number of researchers provided their ideas to implement and find the solution by using clustering methods. Few methods include Highest Degree heuristic [5] [6], Lowest-ID heuristic [5] [6] and Node Weight heuristic [5] [7]. In Highest Degree heuristic method, Cluster head will only get appointed on the basis of its connectivity with maximum number of neighbors and tie, if any, can be broken by unique node ids and degree of a node is always calculated based on its distance from other nodes. Due to these reasons, it is called also as Connectivity-based clustering. Lowest-ID heuristic is all responsible to assign unique id to every node. In this, Cluster head selected on this unique id value. Node with minimum id than its unique id assigned to neighboring nodes, shall be selected as Cluster head. Therefore, it is known as Identifier-based clustering too. Node Weight heuristic method assign a weight to every node on basis of its mobility or any other parameter, so that node can be identified to be selected as cluster head. Node with higher weight than all its neighbors weight could be assigned as Cluster Head, otherwise joins neighboring cluster head. These methods were having certain shortcomings that put constraints on network to select cluster head only on the basis of a particular parameter and ignoring rest all features. To find a cluster head, a method defined with Weighted Clustering Algorithm (WCA), as name introduced, that considers multiple factors to compute node weights and improved the route discovery also through clusters. One of other paper [8] based on clustering algorithm had also not worked that much on identification of malicious node so that secure efficient network could be managed. In WCA algorithm, few parameters included are mobility of node, degree of each node by which it is connected with other nodes, degree difference, packet drop ratio, etc. are taken. Network stability is also done in it by using re-clustering when high movement of nodes are there, along with route optimization using fuzzy logic for selection of best path. It include fuzzification, inference engine and defuzzification [9]. Optimal Zero Knowledge protocol has

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been proposed and discussed in [10]. This research improves the postural mobility and security in BANZKP by using random key allocation method. This research increases the percentage of received packets by 34.06% and reduces the end to end by 8.75%. Multi-Graph Zero Knowledge based Authentication system is discussed in [11] for Internet of things. This research has compared their model with GMW-ZKP, M-ZAS and claim high performance and protection in terms of security. In addition this model claims lower transmissions heads in comparison to Zero Knowledge Protocol. Two novel non-interactive identity based data transmission protocols has been presented in [12]. This research provide confidentiality protections and integrity for transmitted messages. Moreover this research claims that underwater vehicles can transmit can transmit messages directly without any prior authentication. Secure Authentication Method for Smart Homes is designed in [13]. This research suggests to make use of zero knowledge proof without the use of secret keys. This research provided a way to reduce the burden on home gateway for managing secret keys. Review of non-interactive Zero Knowledge proof systems is given in [14]. This research explains Zero Knowledge Systems on NP problems and non-interactive statistical methods. Novel Approach for enhancing performance of Cognitive Radio Networks is proposed in [15]. This research proposed channel acquisition schemes and self co-existence mechanisms for CR networks.

COMPARISON DATA:

As per routing protocols in Table 1, Reactive Protocols have less overhead due to their loop free behavior and support to multipath routing. These features also make it able to handle wide variety of traffic patterns. In Proactive protocols, information related to routing is considered as usually accurate because periodically update messages are being shared with neighbors. In this, Clustering is also possible as it is assumed that for a time period, nodes remain part of it. This all is done to select shortest path to destination. In hybrid protocols, less overhead generated. Traffic will also reduce and single point of failure could also be avoided. As per hybrid protocols defined in table, it is important to properly configure each zone for better communication inside the zone as well as outside the zone.

Protocol Name	AODV	DSR	DSDV	CSGR	ZRP	ZHLS
Protocol Type	Adhoc On Demand Distance Vector	Dynamic Source Routing	Destination Sequence Distance Vector	Cluster Switch Gateway Routing	Zone Routing Protocol	Zone Based Hierarchical Link State
Approach used in Routing	Reactive	Reactive	Proactive	Proactive	Hybrid	Hybrid
Route Selection method	Updated shortest path	Updated shortest path	Link State	CSGR works as per strategy of shortest path.	Link reversal	Node id and Zone id of destination are required.
Routing Table	Every node has to maintain one table in which routing information of next hop for destination node is stored.	Supports Multipath routing. So, Route cache and Full route to destination must be available.	Maintain complete address to every destination by every node.	Need to maintain atleast two tables: Routing table and Cluster member table	Route table	Node level and Zone level topology must be defined.
Route	Route	Supports two	Routing	Routing table	Link	Knowledge of

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| Maintenance | maintenance done with Sequence number and Broadcast ID | processes i.e. Hop by Hop acknowledgement and End to End acknowledgement | table must be maintained by each node | must be maintained by each node that determines next hop to reach destination. | reversal and information stored in link table | node LSP and Zone LSP are required for inter zone and intra zone communication. |

TABLE 1. Comparison of Routing Protocols

CONCLUSION AND FUTURE WORK:

In paper [1], solution to single path problem at time of node failure, selected as router, is although given, but it was not discussed that if any malicious node will enter in such wireless communication, especially, mobile system, then how malicious node will be identified. It means that this may lead to us towards compromising security, as system is always leaving a scope to verification of malicious node. Once malicious node will be selected as any intermediate node, data will be made available to it automatically. Paper [4] also focused more on reliability to increase throughput, but solution to prevent from malicious node is not considered. This malicious node may occur in any path either the selected path of communication or an alternate path. Paper [5] talked about so many methods to make routing effective and more efficient and therefore Weighted Clustering Algorithm (WCA) was also designed in which multiple factors were taken into consideration before selection of Cluster head, but all these multiple factors fail if there exists any malicious node in network and malicious node is getting control of packets too because some weight was assigned to it. By doing this, all efforts to make network more effective wasted. Therefore, Security is must in such wireless network in which possibility of any node is always be there. WCA did work on Malicious node detection, but same as the problem of cluster head selection in earlier methods, WCA left some scope in which by simply removing a node after checking its Packet Drop Ratio, may remove any authenticated node too. This authenticated node have high Packet Drop Ratio due to some reasons. Therefore, there is need to include more accuracy and effectiveness in result to identify a malicious node in some better way without actually disturbing other authenticated nodes. There must be quite less possibility in which an authenticated node should be removed from network. For this, Authentication can be achieved with help of Zero Knowledge Proof algorithms, by which at least identification of authenticated node and malicious node should be easily achieved. These Clustering algorithms start integrating with Zero Knowledge Proof algorithms and routing protocol using clustering algorithm allow only those nodes to communicate those are identified as authenticated from Zero Knowledge Proof algorithms.

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