ROUTING PROTOCOLS IN WIRELESS MOBILE Ad-hoc NETWORK- A REVIEW

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ABSTRACT

This paper presents a literature review of current routing protocols used in mobile ad hoc network (MANET). Routing is a most challenging issue in ad hoc network since nodes are mobile and the dynamic nature of the topology. Routing metrics such as shortest path, QoS, power consumption and position location are being used to reduce discovery time and also message update cost. This paper presents a thorough overview of some of the QoS routing protocols along with their strengths and weaknesses. A comparative study of the reactive, proactive and hybrid QoS routing protocols is done and in addition, the current issues and future challenges that are involved in this exciting area of research are also included.

Keywords*:* MANET, QoS, Routing Protocols, Proactive Routing, Reactive Routing , Hybrid Routing, Protocols comparision.

1. INTRODUCTION

IETF (Internet Engineering Task Force) evolved MANET since 1980[1]. An Ad-hoc network is a collection of mobile devices that can dynamically move and can recognize themselves and communicate over wirelessly. Packets are forwarded in peer-to-peer mode via multi-hop path from source to destination. There is no centralized control to organize the routing path like wired infrastructure. Routing to nodes, this needs to be determined before or after the reception of packets.

MANETs consist of mobile platforms known as nodes or motes, which are free to move around arbitrarily. These nodes are very small, may be located in buildings, bridges, vehicles or sometimes in battlefield. Each node or mote equipped with an antenna that can receive and transmit signals. Motes are standalone device and operated using batteries. It is possible to implement in small time period and it has no infrastructure.

2. CHALLENGES

MANET nodes are equipped with wireless receivers and transmitters along with antennas that can be omni directional for broadcasting, highly- directional for point-to-point communication, possibly steerable, or some combination thereof. Depending on the nodes' positions and their transmitter and receiver coverage patterns, at a given point in time, transmission power levels and co-channel interference levels, a wireless connectivity in the form of a random, multi-hop graph or "ad hoc" network exists between the nodes. This ad-hoc topology may change with time as the nodes move or adjust their transmission and reception parameters. Some important features of MANET are summarized below:

i. Reliability

Challenges to achieving reliability on Wireless Sensor Networks can be divided into three main categories. Problems are related to the wireless communication. The asymmetries of links make estimation of link quality estimation hard and invalidate many assumptions made in other environments. Correlated losses due to obstacles, interference, can lead to consecutive losses, decreasing the effectiveness of erasure code. Weak correlation between quality and distance, hidden terminal problems, and dynamic change of connectivity complicates the situation further [2][3].

ii. Low-Power Consumption

Normally nodes in the wireless sensor networks are battery powered. So they are expected to work for many years, in order to work long period of time. They must have some kind of an algorithm to save power they consuming. So the best practice is to implement a good routing protocol for wireless sensor network. In order to do that it needs to observe the existing technologies that are already used at the past few years to achieve lower power consumption in wireless sensor networks [2][3].

iii. Compatibility of Internet Protocol Version 4 and 6

Internet Protocol Version 6 (IPv6) is the designated successor of IPv4 as the network protocol for the

Internet. To overcome the increase in networked devices which will outnumber the conventional computer hosts Ipv6 was introduced and it expands the address space from 32 bits to 128 bits. The most widely used link technologies evenly split the IPv6 address space into a subnet prefix that uniquely identifies the subnet within the internet and an interface identifier that uniquely identify an interface within the subnet. Authors are trying to overcome the current issues in wireless sensor networks; concentrating on its Reliability, Power management, Security and Ipv6 Compatibility [2][3].

iv. Security

Wireless networks are vulnerable to security attacks due to the broadcast in nature of the transmission medium. Furthermore, wireless sensor networks have an additional vulnerability because nodes are often placed in a hostile or dangerous environment where they are not physically safe. In many applications, the data obtained by the sensing nodes needs to be kept confidential and it has to be authentic. In the absence of security a false or malicious node could intercept private information, or could send false messages to nodes in the network. The major attacks include Eavesdropping, Spoof Attack, Denial of Service (DOS), Worm hole attack, Sinkhole attack, Sybil attack, Selective Forwarding attack, Passive information gathering, Node capturing, False or malicious node, Hello flood attack etc[2][3][4].

3. ROUTING AND DESIGN OBJECTIVES

Routing is the process of selecting best path in a network along which to send network traffic. Routing is performed for many kinds of networks, including the telephone network (circuit switching), electronic data networks (such as the Internet), and transportation networks. This article is concerned primarily with routing in electronic data networks using packet switching technology. In packet switching networks, routing direct packet forwarding, the transit of logically addressed packets from their source toward their ultimate destination through intermediate nodes, typically through hardware devices called routers, bridges, gateways, firewalls, or switches. General-purpose computers can also forward packets and perform routing, though they are not specialized hardware and may suffer from limited performance. The routing process usually directs forwarding on the basis of routing tables which maintain a record the routes to various network destinations. Thus, constructing routing tables, which are held in the router's memory, is very important for efficient routing. Most routing algorithms are use on one network path at a time, but multipath routing techniques enable the use of multiple alternative paths.

Since ad hoc network are self-organized, broadcasting to all nodes must be avoided because it creates flooding at the nodes. An alternative route should be identified to act as a backup if node failures occur. One of the major challenges in designing a routing protocol for ad-hoc is to determine reliability because of the dynamic nature of the infrastructure.

Many routing protocols have been proposed for MANETs, but none of them has good performances in all scenarios with different network sizes, traffic loads and node mobility patterns. Each of the proposed protocols is based on different principles and has different characteristics, so their classification is necessary. Usually, classification is made based on characteristics related to the information which is exploited for routing and roles which nodes may take in the routing process. They can be classified into three main categories: Proactive, Reactive and Hybrid. Proactive protocols are routing algorithms that will periodically and continually update routes in the network, so that when a packet need to be transmitted A to B, route the destination are already known and can be forwarded straight away.

When using proactive routing protocols, also called "table driven" protocols, mobile nodes continuously evaluate routes to all reachable nodes and attempt to maintain consistent and up-to-date routing information, regardless of whether data traffic exists or not. The advantages of this type of protocols are discovery of the shortest path through network and availability of routes at the time of need, which reduces delays. The lack of proactive routing protocols is providing a resistance to network topology changes. On the other hand, when mobile nodes use reactive routing protocols, also called "on-demand" protocols, route discovery operation is performed only when a routing path is needed, and it is terminated when a route or no route has been found. A very important operation in reactive routing is route maintenance. The advantages of this type of protocols are efficiency, reliability and less control overhead. However, a major drawback is a long delay caused by a route discovery operation in order to transmit data packets. Hybrid routing protocols are proposed to combine the merits of both proactive and reactive routing protocols and overcome their shortcomings.

Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV)[6], Cluster Gateway Switch Routing Protocol (CGSR) [7], Global State Routing (GSR)[6], Fisheye State Routing (FSR)[13], Hierarchical State Routing (HSR) [19],Source Tree Adaptive Routing (STAR)[9], Distance Routing Effect Algorithm for Mobility (DREAM) [17] are examples of proactive routing protocols. On the other hand reactive routing protocols are route computation only on demand. Examples of these reactive protocols are Ad-Hoc On-Demand Distance Vector (AODV)

Routing Protocol[2],Dynamic Source Routing (DSR) protocol [8],Temporally Ordered Routing Algorithm (TORA) [11],Associativity-Based Routing (ABR) [12],and Cluster-Based Routing Protocol (CBRP)[18].Hybrid routing protocols are combination of the merits of both proactive and reactive routing protocols and overcome their shortcomings. Examples of these Hybrid protocols are Zone Routing Protocol (ZRP) [13], Zone-Based Hierarchical Link State Routing Protocol (ZHLS) [14].

4. METRICS USED IN CURRENT ROUTING PROTOCOLS

QoS and reliability consists of a set of characteristics or constraints between the source and the destination that a connection must guarantee during the communication in order to meet the requirements of an application [1] [2]. To judge the merit of routing protocol, one needs metrics both qualitative and quantitative, with which to measure its suitability and performance [4]. Generally, there are four main metrics presented in [5] as parameters of QoS which are probability of packet loss (or packet delivery ratio), delay (route latency), jitter (delay variance), and bandwidth. According to RFC2501 [4] authors listed both quantitative and qualitative properties of MANET. Among the metric values are applied to compare the reactive, proactive and hybrid ad-hoc protocols by considering overhead, loop-freedom and scalability.

RFC2501[4] discussed end-to-end delay, throughput, overhead, packet delivery ratio and mobility as quantitative metrics. On the other hand loop-freedom, route stability, on-demand, scalability and reliability are discussed as qualitative metrics.

table is sent to the neighbors, whereas in case of incremental update, only the entries that require changes are sent

Table 1: Basic characteristics of proactive routing protocols

Protocol	Routing Structure	Number of Tables	Frequency of Updates	Hello Message	Critical nodes	Characteristic Feature
DSDV	Flat	2	Periodic & as required	Yes	No	Loop Free
WRP	Flat	4	Periodic	Yes	No	Loop freedom using predecessor info
GSR	Flat	3 & a List	Periodic and Local	No	No	Localised updates
FSR	Flat	3 & a List	Periodic and Local	No	No	Controlled frequency of updates
DREM	Flat	1	Mobility Based	No	No	Controlled rate of updates by mobility and distance
STAR	Hierarchical	1 & a 5 Lists	Conditional	No	No	Employes least overhead routing approach and/or optimum routing. approach Minimize control overhead
CGSR	Hierarchical	2	Periodic	No	No	Clusterheads exchange routing information

A.Proactive Routing Protocols

Table 1 shows a comparison of various routing scheme and there characteristics of proactive routing protocols. In the table routing structure, number of tables, and frequency of updates, Hello message, critical nodes and characteristic features are compared.

i.DSDV as Proactive Routing Protocol

DSDV [6] is a Proactive routing protocol that solves the major problem associated with distance vector routing of wired networks for instance, Count-to-infinity, by using destination sequence number. In this routing protocol, each mobile node in the network keeps a routing table (two tables). Each of the routing table contains the list of all available destinations and

the number of hops to each. Each table entry is tagged with asequence number, which is originated by the destination node. Periodic transmissions of updates of the Routing tables help maintaining the topology information of the network. If there is any new significant change for the routing information, the updates are transmitted immediately. Hence, the routing information updates might either be periodic or as required. The routing updates could be sent in two ways: ‘‘full dump’’ and ‘‘incremental.’’ In case of full dump, the entire routing

ii.WRP as Proactive Routing Protocol

WRP[20] defined as the set of distributed shortest path algorithms that calculate the paths using information regarding the length and second-to-last hop of the shortest path to each destination. WRP reduces the number of cases in which a temporary routing loop can occur. For the purpose of routing, each node maintains four tables: 1. A distance table 2. A routing table 3. A link-cost table 4. A message retransmission list (MRL). WRP uses periodic update message transmissions to the neighbors of a node. Each time the consistency of the routing information is checked by each node in this protocol, which helps to eliminate routing loops and always tries to find out the best solution for routing in the network.

B.Reactive Roting Protocols

Table 2 shows the comparison of various routing scheme and there characteristics of reactive routing protocols. In the table AODV, DSR, ABR, TORA and CBRP which uses route discovery and flat routing and route reconfiguration strategies and basic characteristics are compared.

Table 2: Basic characteristics of reactive routing protocols [2,3,4,5,6,7,8]

Protocol	Routing Structure	Multiple Routes	Bacons	Route Metric Method	Route Maintained in	Route Reconfiguration Strategy
AODV	Flat	No	Yes, Hello Message	Freshest & Shorted Path	Route Table	Erase route then Source Notification or local route repair
DSR	Flat	Yes	No	Shorted Path or Next available in route cache	Route Cache	Erase route the Source Notification
ABR	Flat	No	Yes	Strongest Associativity & SP	Route Table	localised broadcast query
TORA	Flat	Yes	No	Shorted Path or Next available	Route Table	Link reversal & Route repair
CBRP	Hierarchical	No	No	First available route(first fit)	RT at cluster head	Erase route then Source Notification & local route repair

i. AODV as a reactive routing protocol

AODV [2][7] is a single-path, reactive routing protocol. Route discovery is using a route request (RREQ) – route reply (RREP) cycle. When a source node has data to be sent to a destination node and does not know the route to the destination node, floods a route request (RREQ) packet throughout the network. Several RREQ packets, each travelling on a different path, will reach the destination. The destination node replies (RREP packet) only to the first RREQ packet and drops subsequent RREQ packets with the same source sequence number and broadcast ID. The RREQ packet that arrived at the earliest is likely to have traversed a path with low delay and/or hop count. Representing the weight of each link in the network by the delay incurred on the link, AODV reduces to finding a minimum-weight path between the source and the destination.

ii.DSR as a reactive routing protocol

DSR[6] requires each transmitted packet to carry the full address from the source to the destination likewise the mechanism used in AODV. It uses the shortest hop path from the source to the destination. Thus, the source learns multiple route to the destination and stores them in the route cache. It does not check for node disjoint or link disjoint properties before using these routes. DSR fits into the category

of routing protocols based on minimum weight path routing.

C.Hybrid routing protocol

Table 3 shows the comparison of various routing scheme and there characteristics of hybrid routing protocols. In the table ZRP and ZHLS which uses route discovery and flat routing and hierarchical and basic characteristics are compared.

i. ZRP as Hybrid Routing Protocol

ZRP[13] is a hybrid routing protocol which effectively combines the best features of proactive and reactive routing protocol [13,14]. Each node defines a zone around itself and the zone radius is the number of hops to the perimeter of the zone. The reactive global search is done efficiently by querying only a selected set of nodes in the network [15]. The number of nodes queried is in the order of [r zone / r network]2 of the number of nodes queried using a network-wide flooding process [13].Unless the zone radius is carefully chosen, a node can be in multiple zones and zones overlap.

ii. ZHLS as Hybrid Routing Protocol

ZHLS [2], the network is divided into non overlapping zones as in cellular networks. Each node knows the node connectivity within its own zone and the zone connectivity information of the entire network. The link state routing is performed by employing two levels: node level and global zone level. The zone level topological information is distributed to all nodes. Since only zone ID and node ID of a destination are needed for routing, the route from a source to a destination is adaptable to changing topology. The zone ID of the destination is found by sending one location request to every zone.

Table 3. Basic characteristics of hybrid routing protocols[14,15,16,18]

Protocol	Routing structure	Multiple Route	Bacons	Route Metric Method	Route Maintained in	Route Configuration Strategy
ZRP	Flat	Yes	Yes	Shortest path	Interzone and interzone tables	Router Repair at point of Failure & Source Notification
ZHLS	Hierarchical	No	No	Shortest path	Interzone and interzone tables	Location Request

5.CONCLUSION

This paper presented an exhaustive survey about existing routing protocols, and comparison between the different methods proposed, most of its conclusions pointed to a phenomenon, not a routing protocol can adapt to all environments, whether it is Table-Driven, On-Demand or a mixture of two kinds, are limited by the network characteristics; highlighting their features, differences. Mobile ad-hoc networks consist of a large number of nodes that moves in dynamic infrastructure and operate on batteries. In order to maintain reliability and reduce discovery time the network should be hierarchical. Other than that link quality, alternative routing path

and mobility prediction of nodes helps to reduce probability of the failure of links, but it increases in destination rehabilitee

6.REFERENCES

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