A Survey on Reliable Routing Protocols using Received Signal Strength in MANET

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Abstract— A Mobile Ad Hoc Network is a collection of portable devices that establish communication without the help of any infrastructure such as base stations or access points. As the MANET is infrastructure less, it is having dynamic nature and random network topology. Due to random movement of nodes, the link between the nodes breaks repeatedly. When the link breaks MANET needs to find route again, which can increases the routing load of the network. Many efforts have been made to design reliable routing protocols that enhance route stability in network. Some of recently published papers consider received signal strength as an effective parameter to enhance route stability. In this paper, we survey on recently published papers which gives reliable routing protocols which uses received signal strength as a parameter to enhance the stability of route.

Index Terms— AODV, Routing, MANET, Stability, Signal strength, Cross-Layer, QOS

1 INTRODUCTION

A Mobile Ad Hoc Network (also called MANET) is a collection of portable devices that establish communication without the help of any infrastructure or established communication backbone [1]. Furthermore, Mobile Ad hoc networks are easy to deploy and does not require any back bone support. MANET is Useful in the absence of infrastructure. MANET is used many applications, such as, Military environments, Soldiers, tanks, planes, taxi cab network, Emergency operations, search, rescue, policing etc. Each device in a MANET is free to move independently in any direction, therefore change its links to other devices over and over again. Mobile Ad Hoc network are self-organizing, multihopping, mobile and scalable. Each node in MANET is equipped to continuously maintain the information regarding route. Topology of the ad-hoc network depends on the transmission power of the nodes and the location of the portable nodes, which may change from time to time [1].

The main goal of Ad Hoc routing is to send data packets among nodes distributed randomly in the network. Since mobile ad hoc networks have random topology, routing in such networks is a tough task. There is so much work has been done on routing in ad hoc networks [1].

Routing is the process of finding a path from a source to destination. The broadcasting is usual and a common operation in ad-hoc network. It consists of diffusing a message from a source node to all the nodes in the network. Broadcast can be used to diffuse information to the whole network. It is also used for route discovery protocols in ad-hoc networks. The routing protocols are classified as follows on the basis of the way the network information is obtained in these routing protocols.

1) Proactive (Table-Driven) Routing Protocol
2) Reactive (On-Demand) Routing Protocol
3) Hierarchical Routing Protocol
4) Hybrid Routing Protocol

Proactive (or Table-driven) routing protocols maintain routing information about each node in the network. The information is updated throughout the network periodically or when topology changes. Each node requires storing their routing information. For example: Destination sequenced Distance vector routing (DSDV) [10].
Reactive or On-demand routing protocols look for the routes and are created as and when required. When a source wants to send to a destination, it invokes the route discovery mechanisms to find the path to the destination. For example:
Ad-Hoc On-demand Distance Vector (AODV) [9], Dynamic Source Routing (DSR) [11]
In Hierarchical routing protocol Nodes are organized in clusters, Cluster head "controls" cluster, one or multiple levels of hierarchy
In Hybrid routing protocol, Proactive for neighborhood, Reactive for far away (Zone Routing Protocol), Proactive for long distance, Reactive for neighborhood (Safari)

The routing protocols for mobile ad hoc network are generally minimum hop based. These protocols try to find the route

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such that the route contains minimum number of intermediate node. The problem with minimum hop based route is that they tend to fail due to changing network conditions. The topological change in a mobile ad hoc network will take nodes out of each other's transmission range and the route may break.

The minimum hop route found using routing protocol may have weak links so, after certain time interval the route tend to break. If the active route breaks then route discovery process is initiated which consist of broadcasting route request packets. The route discovery procedure increases a routing overhead of routing protocol. If the discovered route is not stable then it will lead to multiple route discoveries this will affect the performance of the network. If we find a route that is stable or whose life time is longer then there will be lesser route discoveries than usual and we may get good packet delivery ratio.

There are several approaches used to achieve stability in Ad Hoc Network routing protocols [2]. The different approaches used different parameters to achieve stability like node residual energy, link expiration time , link available time, stability of nodes, node successful data transmission, received signal strength etc.

Kwan-Wu Chin et al. [3] have implemented MANET routing protocols. Using this implementation the authors have found out that the selected route using the AODV and DSDV protocols does not have a reliable link. The protocols normally select closest neighbors but they do not check whether the link is reliable or not.

They proposed signal quality based route selection, in that way the resulting route is more stable and remain active for longer time. They suggested that the received signal strength could be a better parameter to achieve stability.

We surveyed the reliable routing protocols which are using received signal strength to improve the stability of the route. Following sections describes various protocols which find stable path using received signal strength.

2 Received Signal Strength based Reliable Routing Protocols

2.1 Received Signal Strength-based Cross-layer designs for mobile ad-hoc network

B.Ramchandran and et al. [4] used received signal strength as a parameter in cross layer design. In a cross layer design the parameter received at a one layer can be communicated to other layer. The authors presented the design in which the Received signal strength measured at the physical layer is communicated to network and MAC layer.

The author indicates that using the received signal strength we can address various issues like energy conservation, unidirectional link rejection and reliable route formation. For reliable route discovery the RREQ (route request) packet is only forwarded to the destination if it is having the received signal strength which is higher than some predefined Threshold. Thus the links on which the received signal strength is low will not participate in formation of route.

There are two types of threshold policies has been used in the paper which is

(1) Fixed threshold

(2) Adaptive threshold

In fixed threshold methodology the predefined threshold remains fixed for different speeds of mobile node while in Adaptive threshold policy the threshold value change according to the speed of mobile nodes. The adaptive threshold policy also considers the moving direction of nodes.

In order to find the moving direction of mobile node the received signal strength of RREQ packet is stored in the neighbor table against the neighbor from which it is received. Whenever any node receives RREQ from its neighbors the current received strength is compared with stored received signal strength , if current received signal strength is better than previous received signal strength then it indicates the nodes are approaching otherwise they are going away from each other.

If the nodes are approaching and even if their received signal strength is less than threshold the RREQ packet is processed and forwarded to the next node.

2.2 Routing technique with cross layer approach in Ad-Hoc Network

Boumetjout et al. [5] had introduced a new routing protocol AodvPw which uses the received signal strength information to enhance the stability of ad hoc network.
In AodvPw protocol, the received signal strength information is used to compute path loss incurred to choose reliable links by monitoring the signal quality to judge which route is chosen in the route discovery process.
The aodv protocol has hop count as metric but AodvPw has path loss as metric experienced as,

Path loss= PT - PR (1)
Where PR is Received Power and PT is Transmission Power.

The path loss metric is incorporated in Aodv protocol by adding a path loss field to the RReq and RRep Aodv packets to sum the path loss from the source to the destination and vice versa. Another field called Rt_puissloss is adding to the Aodv routing table to save the average path loss from the source to the destination node experienced as,

Rt_puissloss= path loss (from source to destination) /hop count (2)

Noted that the source node initialize the path loss field in the RREQ Packet to 0.

When a sending node broadcasting RREQ packet, it piggy backs its transmission power PT. On receiving the RREQ packet, the intended receiving node measures the received signal strength PR according to the using propagation model.

Hence the receiving node calculates the path loss using formula (1), adds it to the RREQ's path loss field calculates the average path loss using formula (2) and stores it in its routing table.

Even If the receiving node has already received this RREQ packet it verify if it has fresher sequence number than the one saving in its routing table or lesser average path loss with the same sequence number, if it's the case it updates its routing table by fresh RREQ information such as sequence number, hop count and average path loss experienced by RREQ's path loss / RREQ's hop count. So the route selected to forward information is the one with lesser average path loss not the one with lesser hop count from the source to destination.

The destination node sends the RREP packet with the adding field path loss to sum the path loss in the reverse route and updates the nod's routing table by the average path loss of the selected path.

2.3 AODV-RSS

Ruay-Shiung Chang et al. [6] have illustrated about new protocol AODV-RSS, which is a modified version of AODV protocol. This protocol also utilizes cross layer design to achieve received signal strength information.

The aim of this protocol is to determine paths that are long lived means to find a route that can sustain for a longer time. The long-lived path routing algorithm uses the Received Signal Strength RSS and Received Signal Strength changing rate Δ RSS to predict the link available time (LAT) between two mobile nodes. AODV-RSS can improve the route quality in route connection time, and route reestablishment frequency.

2.4 Signal Strength based Congestion control in MANET

Prof. Shitalkumar Jain et al. [7] have reviewed a signal strength based measurements to improve upon packet losses and retransmission of packets. Their goal was to improve TCP performance by using signal strength based cross layer approach which obviously resolves the congestion. Node based and link based signal strength can be measured. If a link fails due to mobility, then signal strength measurement provides temporary higher transmission power to keep link alive. When a route is likely to fail due to weak signal strength of a node, it will find alternate path. Consequently avoids congestion. They made changes at MAC routing and routing layer to predict link failure. They have selected two routing protocols AODV and DSR. Packet Delivery Ratio, Packet Drop, Throughput and end to end delay are the metrics used for performance analysis of the AODV routing protocols.
As a result of their studies, they found increase performance of TCP which automatically improves congestion. Cross layer approach, TCP performance, signal strength and mobility these four parameters can be used to improve congestion control. They make a temporary increase in the transmit power level when a node moves out of range to temporarily reestablish the failed link. This would enable the TCP packets that are already in flight to traverse the link. Their algorithms can considerably reduce the number of packet losses. Consequently the number of TCP re-transmission time-outs is reduced and the TCP sources send more packets.

2.4 Route Stability Based QoS Routing in Mobile Adhoc Networks

Nityananda Sarma et al. [8] have proposed a Route Stability based QoS Routing (RSQR) protocol in Mobile Ad Hoc Networks (MANETs) which is an extension of QoS routing with throughput and delay constraints. In order to guarantee the suitable data path for adequate longer duration in MANET, they have proposed easy model for measuring the link stability and route stability depending on received signal strengths. Some additional fields in route request/ reply packets is taken into consideration so that the route stability information can be used to choose a route with increased stability when compared to all possible routes among existing source destination pair.

3 Conclusion

Majority of existing MANET routing protocols uses minimum hop approach to find the route. They broadcast route discovery packets in order to find a new route. The minimum hop path is selected as a route. If the selected path contains weak links then the route is prone to failure. Repeated failure of route may increase the number of route discovery, which will in turn increase the routing load of the network. There is a need to consider a parameter other than minimum hops in order to improve the stability of the route. Some of the recent papers suggest that received signal strength is a better parameter to find a route. The route found by using received signal strength is more stable compared to the route found by some existing MANET routing protocols. The stable route remains active for a longer time which eliminates need for frequent route discovery. The use of received signal strength reduces routing overhead, improves packet delivery ratio and throughput of the network.

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