International Conference on Network Applications, Protocols and Services 2008 (NetApps2008)
21 - 22 November 2008
Executive Development Center, Universiti Utara Malaysia

A New Routing Protocol for Wireless Ad-Hoc Networks

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***Abstract*-In recent years, a number of routing protocols for Mobile Ad Hoc wireless networks have been developed and have found many applications including multiple routing protocols In Ad-Hoc mobile network, multi-hop wireless links are popular applications as they are less routing overhead in order to reduce the network congestion as well as bandwidth utilization. In this paper, we studied the Ad-Hoc On-demand Distance Vector (AODV) Routing protocol with deep analyzing. Then we have proposed a Direct Forward Routing Protocol scheme (DFRP) where the new approach is built on demand and maintained by direct forward mechanism through a double functions agent node. This double function forwarding node was built and equipped with at least two hopes connectivity. In other words, if an intermediate node has discovered that the next forwarding node to the destination is moved from the network and it is no more its neighbor, then on behalf of the moved node; the current node has ability to forward direct to the next hop (the moved node's neighbor) for the moved node. This means that the moved node neighbors perform as a neighbor of the current node. In addition, the source node will not broadcasts a Route Request packet on its entire neighbors, it just broadcasts half of nodes in order to avoid the network congestion and deliver the packet to the destination routes with minimum overhead. This new protocol comes up a very useful mechanism which eliminates the route regenerating by the source as well as repair or local repair and many other mechanisms when a route breaks due to node mobility or failure. This study aims at enhancing the AODV Quality of Service (QoS) capabilities by DFRP to mitigate the route breakdown of ad hoc networks.**

Key Words- Direct Forwarding, minimize broadcasting, Route and distances updating for every 60 sc

I. INTRODUCTION

Over the last decade, the extensive growth of the Internet has led to an increasing demand for high-speed Internet access. The choice of broadband Internet access is normally constrained to DSL and cable-modem based connections. Bluetooth- IEEE 802.15.1(Wireless Personal Area Networks), WiFi-IEEE 802.11n (Wireless Local Area Networks) and WiMAX-IEEE 802.16 (Wireless Metropolitan Area Networks) are increasingly gaining the useful of global deployment for both internet access and Voice utilities [1]

These cordless technologies can help to bridge the digital wise in both education and research mode. In addition, developing and implementing broadband Wireless technologies, can lead to overcome the challenges of both ground-infrastructure and finance issues. Especially, developing countries and rural areas which not installed optical fiber or copper wire infrastructures for broadband services and same time the investors unwilling to install the necessary equipment for the areas with little profit. Nonetheless, there is no argument that these wireless technologies can be considerably less expensive and time consuming to deploy than wired infrastructures ones. In this work will be emphasized by mobile ad-hoc network and mainly be focus on routing protocols which the performance of Ad hoc networks is extremely depended on routing protocol. There have been developed and implemented many ad hoc routing protocols and they are categories into different classes. Where the common routing protocols used in Mobile Ad hoc Networks (MANETs) are Ad-hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR). These two protocols are the most widely studied on demand ad hoc network routing protocols.

Subsequently numerous other protocols are being developed/modified both proactive and reactive routing protocols like dynamic Destination-Sequenced Distance-Vector routing' (DSDV), Optimized Link State Routing (OLSR), Topology Broadcast based on Reverse Path Forwarding (TBRPF), on-demand routing protocols such as Dynamic Source Routing (DSR), Signal Stability-based Adaptive routing (SSA), and mixed routing

protocols such as the Zone Routing Protocol (ZRP) and many others [2] [3].

AODV [4] is a popular route protocol for ad hoc network. This protocol is a reactive protocol, in other words, it uses an on-demand mechanism which means that it discovers routes only when a source node needs them. It has very useful mechanism and it's suitable for ad hoc network which means that it has ability to maintain routes even when the topology of the network is dynamic. Reactive protocol like AODV is suited for MANET as it has low processing and memory overhead in order to minimize the overall network utilization. Moreover, this protocol uses loop freedom mechanism through the use of sequence numbers for all routes. The way AODV route request proceed in order to communicate each other: Firstly, the source or sender node initiate route discovery through broadcasting Route Request (RREQ) packet then adjacent nodes will forward RREQ until the packet either is reached at the destination or RREQ arrives at the node that has a new fresh route to destination. Secondly, a Route Reply (RREP) is returned to the source (originated route). Once the sender-node receives a RREP, it can begin using that path for data packet transmission. RERR, it's important to inform to the source node that the node which affected by broken link and is used a Route Error (RERR) message. DSR [5] has two mechanisms for Route Discovery and Route Maintenance. The source route is needed when some nodes originate a new packet intended for some nodes through searching its route cache or initiating route discovery using ROUTE REQUEST and ROUTE REPLY messages. On detecting link break, DSR sends ROUTE ERROR message to source for new Route not same route as the route request has came with. In other words, DSR uses source-based routing rather than table-based, it is also an on-demand protocol which has a similar route discovery process to AODV. The main difference between DSR-protocol and AODV-protocol is that the addresses of the intermediate node are accumulated on the DSR RREQ and RREP control packets. To simplify more the way that DSR network exchanges the information, in the network each node uses the information in the RREQ/RREP packets to know about routes to other nodes in the network and store the routes information in their route caches.

The source side when a RREP is received, the source node knows the entire route to the destination. One drawback of AODV-protocol and many other ad-hoc network protocols is the single route concept that requires a source node to establish a new route discovery process whenever a link failure is came across in the current route. Numerous approaches have been developed in order to solve this problem either partial-route re-establishment or Multipath establishment approaches.

The ad hoc network protocols are divided into two categories, namely flat protocols and hierarchical protocols. The flat protocols are all nodes assigned the same functionalities, in addition the flat routing protocols are suitable for small networks containing a small number of nodes and as the network grow up the performance of the flat protocols will be degraded. In contrary, for the hierarchical protocols as depicted figure 1 the network is divided into regions which subset of nodes are assigned to be coordinators; in this respect the hierarchy protocols are developed to solve the scalability problem of the flat protocols. Figure 1 depicts a hierarchy network.

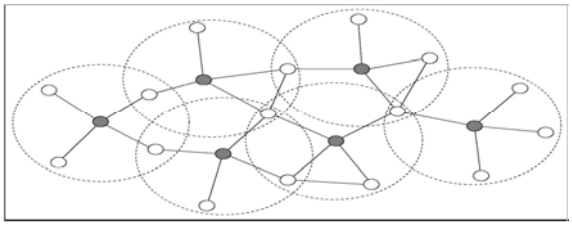

Figure 1. Hierarchy network

In this paper, we present an analytical study subjects to reduce routing delay time and overall network overhead by developing a new scheme in order to overcome the link break due to the ad hoc network mobility. This new concept is maintained by direct forwarding route through a double agent node until the packet is received at the destination, not need repair/local-repair and waypoint which are not even secure to succeed route repairing and same-time they make tremendous overhead and congestion to the network.

II. RELATED WORK

Numerous researches have been done over the last one decade for Ad-hoc mobile network and this sector will be listed view important related topics for our work to give an overview of the research conducted in ad hoc mobile network area and to contrast these approaches with our scheme.

B. Preemptive local route repair (PLRR)

PLRR [6] proposed as an extension to the AODV protocol, denoted Preemptive Local Route Repair

(PLRR). PLRR aims to avoid route failures by preemptively local repairing routes when a link break is about to occur. This approach is to enhance nodes information concerning link stability to its neighbors resorting to HELLO messages. This mechanism, these messages are attached with a new mobility extension containing the node's position, motion vector and an associated timestamp. However, the information of node mobility will be used to predict the instant a link between two neighbors will break. When a node determines that a link between the current node and next neighbor node is about to break, utilizing the information on the location and mobility patterns of both nodes, it triggers the local repair procedure to find a new route to the destination, or to a node with a stable route to the destination, before the previous link actually breaks.

One drawback is that it is even not easy to predict that the node will move from the link, because the nature of ad hoc network mobility, the device or node will suddenly disappear caused by either power failure (down) or device shuts down by the user himself. Therefore, it will be difficult to predict the link will fail because one of the network devices is high movement. It might know only when the link is being fully failed and from that point of view it might only think how to find or create a new route using the best method to avoid the network overhead. In this respect, every time it has to be sent unnecessary data (packets) in order to broadcast information on position and mobility of nodes which makes tremendous network congestion. Therefore, Preemptive Local Route Repair (PLRR) is not the best solution for ad hoc mobile network route discovery, because one major inherent network consideration is network overhead in order to avoid high consumption of bandwidth and network congestion.

B. Way point routing (WPR)

In WPR [7] a number of intermediate nodes on a route are selected as waypoints and the route is divided into segments through the waypoints. In this respect, the WPR scheme was used DSR as the intersegment routing protocol and AODV as the intrasegment routing protocol. This instantiation is termed DSR over AODV (DOA). In this scheme, a number of intermediate nodes on a route are selected as waypoints and the route will be fragmented. In this reverence, sender and destination nodes both are also considered as waypoints, which maintain a hierarchy only for active routes. The main concept of WPR is that the route is divided into segments by selecting a number of waypoint nodes from the route including the source and the destination nodes. The rest of the nodes on the route are termed forwarding nodes. However, the segment starts with a waypoint node called start node and ends with a waypoint node called end node and the start and end nodes of a segment are connected by a number of forwarding nodes. As illustrated figure 2 each two neighboring segments share a common waypoint node, which acts as the end node of the upstream segment and the start node of the downstream segment.

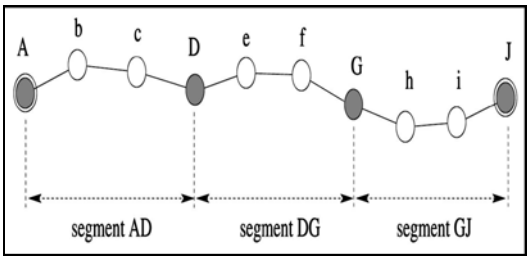

Figure 2. Waypoint mechanism: a route divided into segments

In addition, as illustrated in figure 3, two levels of route repairs are defined in WPR which are intrasegment route repair and intersegment route repair. When original route is broken, intrasegment route repair is tried first and if intrasegment route repair succeeds, waypoint nodes on the source route are not changed. If intrasegment route repair fails, then intersegment or original route repair will be tried next. If intersegment (original) route repair succeeds, the repaired source route is sent to the source and the source will use the repaired route to transmit data packets thereafter. But if both intrasegment and inersegment are failed, route error message is sent to the source node; as a result it may start another round of global route discovery.

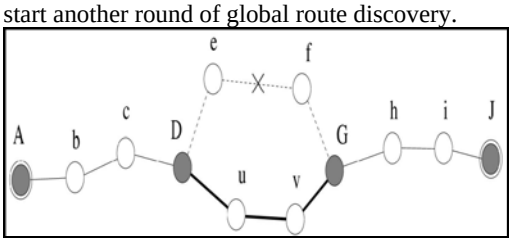

Figure 3. Intrasegment route repair and intersegment route repair

To analyze the WPR mechanism (shown in figure 3), there are two segments or two routes "intersegment and intrasegment" from D, e, f and G is intersegment and from D, u, v and G is Intrasegment. As stated above, the route discovery of WPR works like, if original route is broken then intrasegment route repair is tried to repair the route if not succeed then intersegment or original route repair will be tried next. Finally, if both intrasegment and intersegment

not succeeded which means that the waypoint node it self is disappeared (G-Waypoint disappeared). As a result, the whole original route will be discarded then it should initiate another round of route discovery in order to establish a new route from the source to the destination. Therefore, WPR method ignores the knowledge of the original route and it may cause a significant overhead to re-establish a new global route discovery. This is the subject matter of interest in this research and is obvious that the DFRP outperform WPR in terms of route repairing.

D. Two hops backup routing (2HBR)

2HBR scheme [8] builds two hops alternate paths when replying an RREP packet. This two hops backup routing scheme provides alternate routes for route maintenance procedure in AODV. Although two hops scheme can improve the packet delivery ratio for some instance, but route maintenance procedure will not change much comparing to the AODV-protocol. 2HBR scheme, if there is no an alternate path to be utilized or the link on the alternate path is failed, the 2HBR mechanism will be worthless at all. In addition, the 2HBR scheme is only emphasized the route replaying not route forwarding, in other words, it build two hops alternate paths when replying an RREP packet. However, the two hops backup routing scheme is improved for route discovering with a limit margin and it can be still improved.

D. A Meshed Multipath Routing Protocol

In AODV-MM [9] (AODV with meshed multipath), the route discovery process is basically the same as in AODV except that this scheme is appended some extra information into both RREQ and RREP packets. The route request proceeds, on receiving RREQ packets by intermediate node from its upstream neighbor it will first check if this packet has been received previously or not in order either accept or discard. In other words, if the RREQ has been received previously, the RREQ packet will be discarded but if it is a new RREQ then the RREQ packet will add an entry in its routing table. The route maintenance for AODV-MM Routing Protocol is not mach different from the AODV. It works like that, once a node detects link failure the node that having detected link failure will check up its routing table if there is an alternate path to the desired destination or not. If it does, then the node having detected link failure will use the alternate route as the primary route to destination. Otherwise, the node having detected link failure should send an error message to the source node to restart the route discovery process again which means that if there is no an alternative AODV-MM is basically the same as in AODV because it restart route discovery by source. Therefore, we proposed DFRP protocol to keep away of restarting route discovery process again after the first route is being failure which causes a heavy overhead for the network.

III. AODV-DFRP

We propose a routing protocol to provide a stronger route connection in the ad hoc network to improve the packet delivery ratio with minimum overhead. Our protocol is called the AODV-DFRP (AODV with Direct Forwarding Route Protocol). In this paper, we present an analytical study subjects to reduce routing delay time and overall network overhead by developing a new scheme in order to overcome the link break due to the ad hoc network mobility. This new concept is maintained by direct forward routing Protocol through a double agent node until the packet is received at the destination, not need repair/local-repair and waypoint which are not even secure to succeed route repairing and same-time they make tremendous overhead and congestion to the network.

As illustrated in figure 4, the AODV-DFRP protocol is a mechanism that whenever an intermediate node acknowledges that a link between current node and next shortest hope to the destination is broken, instead to turn to one of its neighbors node in order to find an alternative route, it has direct forwarding ability to leap over the next hop to this broken node i.e. each intermediate node has ability to find a direct route to the destination without invoke either a neighbor node or source node. Our protocol optimizes AODV to achieve effectively in terms of route discovery mechanism and since the possibility of having a failure route is much minimized, thus it mitigates the packet loss, network overhead, propagation delay and jitter delay probability as well. The performance of the protocol will be evaluated through simulation subsequently compare its performance with the related works.

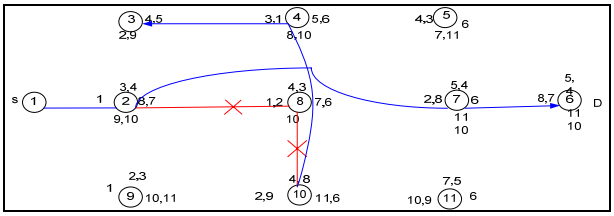

Figure 4. Leap over to next hop

Figure 4 demonstrates an example to illustrate one of the procedures that the AODV-DFRP mechanism comes up. To refer the figure 4 node 1 (S) decided to contact the destination D, doing by that the shortest path to reach that desired destination is from nodes, 2, 8 and 7. Unfortunately one of these intermediate nodes was disappeared because of may be it moved or battery is being down. The nature procedure for the AODV route discovery is that the source node initiates route discovery through broadcasting Route Request (RREQ) packet then adjacent nodes will forward RREQ until the packet either is reached at the destination or RREQ arrived at the node that has a new fresh route to destination. For this instance, the node 1(s) broadcasts RREQ packed into its adjacent nodes in this case the adjacent nodes are nodes 9, 2 and 3. The node 2 received the RREQ from node 1(s) and it tried to forward to the next hop which is node 8, but unfortunately the node 8 was out of the

network, such case has been handled by several researchers through different ways and one common issue to solve like this problem is to broadcast the RREQ into the neighbors to circulate massage until the request either is reached at the destination or arrived at the node that has a new fresh route to the destination. This is the subject matter of interest in this research and as the figure 4 depicted after the node 2 realized that the node 8 which was the shortest route to the destination is disappeared then the massage is forwarded to the next hop toward to the destination instead to circulate to the adjacent nodes and it is obvious that the AODV-DFRP outperform both PLRR, WPR, 2HBR and AODV-MM in terms of route discovering process.

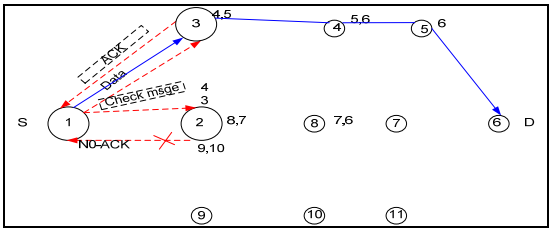

Figure 5. First contact node disappeared

In addition, as shows figure 5 the proposed protocol come up with another mechanism in terms of RREQ broadcasting. The new proposal protocol has built a mechanism that the source will first try to contact the shortest route forwarding node in order to reach the desired destination. By doing that, the source node will not broadcasts a Route Request packet on its entire neighbors, in contrary it just broadcasts only half of its neighbors in order to avoid to circulate an unnecessary massage through the entire network until the request either is reached at the destination or arrived at the node that has a new fresh route to destination as many previous works have been done. This results, less network congestion and delivers the packet to the destination routes with minimum overhead. For instance, in this case the node S has three adjacent nodes say 9, 2 and 3, so the node S first contact to the node 2 and it realized that the node 2 is relocated from the network, and then it switched to the node 3 to continue the route discovering process. In ad hoc networks, the route maintenance of the node mobility is the main reason for routing breakages, thus in this research it maintained by updating links paths which means that each node has to update neighbors about network condition to its segments preferred every 60 sc. It also updates the distance condition which means that when ever a node is going to be reached a given distance (e.g. 800 m) from its neighbors it has to be updated. In this case, the node can join to the other part of the network. This mechanism results in an increase in the effective bandwidth utilization, reduction of network congestion and the probability of a dropped packet in a network.

IV. CONCLUSION

In this paper we propose a new protocol for enhancing ad hoc mobile network technology. The DFRP protocol will be a reliable solution to a number of current ad hoc mobile network shortcomings. In fact, the DFRP protocol could function as an alternative solution and indeed a readily and acceptable mechanism for the overall wireless route discovery enhancement. The protocol is particularly efficient when it comes to better utilization of the route discovery processing as well as traffic reduction. In advance we hope in this protocol will not cause any notable side effect on the overall network health.

FUTURE WORK

We are going to simulate DFRP using NS2-Simulator to evaluate the effectiveness of DFRP and study the performance of the protocol, and compare it to the relevant protocols.

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