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Research paper



A Reliability Improved Routing as a Qos Measure for Mobile Ad-Hoc Networks

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Abstract

In the recent time, the huge expansion in the application of the real-time applications for smartphones resulted in new difficulties when it is time to develop new protocols for mobile ad-hoc networks (MANETS). Most important within these difficulties is to activate real-time applications for mobile ad-hoc networks which includes quality of service (QoS) support, like bandwidth constraints and stability issues. Adding to this of course the reliability of the nodes as an important factor that has a direct effect on the network performance and data integrity.

In this paper we will discussed the QoS main issue that affect several factors in the mobile ad hoc networks, which is the reliability. Because of the fact that the reliability and the availability of the nodes can be interacted made me use both the terms throughout the paper. we will suggest the efficient multi-path Quality of service routing (EMQR), (EMQR) as a QoS guarantee for the stability and reliability issues in the network. Next, we will discuss the availability issues as a QoS guarantee and for this we will suggest the best suitable protocol which is "an efficient warning energy aware Cluster head" WEAC as a solution to the availability issue.

The two protocols will guarantee the availability and the reliability in MANETs as it is the new direction for routing algorithms design and it is a way to enhance the availability by controlling the Cluster head based on its power level as a metric for availability as in WEAC protocol and the reliability by increasing the reserved bandwidth for the route as mentioned in EMQR protocol.

Keywords: *QoS; ad-hoc; networks; EMQR; WEAC; Multi-path; MANETS; availability; Reliability*

1. Introduction

In most routing protocols for MANETs a focus on searching for a convenient path between the destination and the source nodes without considering the support and the resources of application requirement utilization, such as quality of service (QoS). Thus, the main problem of QoS is all about finding a route with the sufficient available resources, and the security and the stability of the routes that meet the QoS elements. Those elements that will be considered in this paper*:*

1. Bandwidth estimation.
2. Route discovery.
3. Bandwidth reservation.
4. Route selection.
5. Route maintenance.
6. Node availability.

For the first five point's falls under reliability, I will suggest the EMQR protocol, for the last point (node availability) I will suggest the WEAC protocol with the suggested enhancement to the flows that it contains.

2. Establishing a Reliable Manet Routing.

2.1. The Reason behind Qos:

As said before, MANET is a dynamic reconfigurable dynamic wireless network that does not have a static fixed infrastructure. Due to the reason of the dynamic mobility of the nodes, the topology of MANETs is changing rapidly, which will make it even more challenging to find a route for the packet to be used. Routing protocols that depends on QoS supports applications that works in real-time like video-audio communications. The used protocols should create a path that guarantees some constraints for QoS to operate on, an example on such constrains are power, bandwidth and even delay.

2.2. The Suggested Protocol Review:

The EMQR (efficient multi-path QoS operating Routing) is suggested to the enhancement of the reliability issue; the suggested protocol is an aware routing protocol scheme for an on demand QoS. We will examine the problems related to the process when the node searches for reliability in the path selection process node in a mobile ad hoc network from a source to a destination. It should also ensure certain specifications to be met by bandwidth.

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We calculate the expiration time for the route (ETR) with the help of GPS between communicating nodes. Then a low latency, stable communication path will be selected using (ETR) and the number of hops.

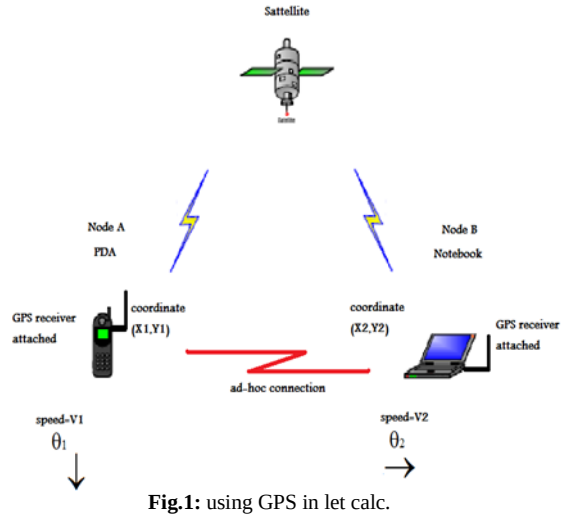


Fig.1: using GPS in let calc.

3. EMQR Anatomy

The mobility of the nodes in the MANETs is considered one of its' main characteristics, and this will be present with frequent topology change. The node, which frequently needs the network's routing information to be refreshed which is a source node in this case. Also, there are so many limits on Mobile ad hoc networks, like bandwidth and power. Because of that, calculating the path that satisfies the requirements of the bandwidth of a quality of service guarantee will be hard because, it is also important for the path found that it keep a high fixed routing and transmission ration during data transmission not only guarantees QoS [1].

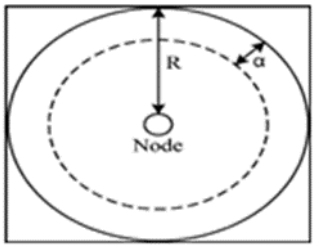


Fig. 2: Node threshold

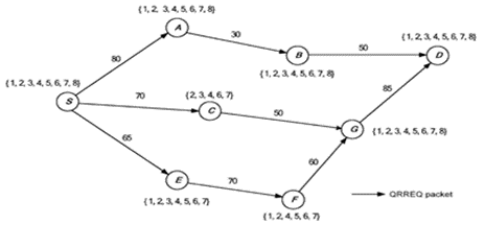


Fig. 3: QRREQ packet delivery

3.1. Link Expiration Time Calculation

As we said about the selected protocol that it has a mobility prediction for the nodes in the networks, this method will be introduced here. It will use the location information provided by the global positioning system. To do that we will synchronize all the clocks of the nodes with the help of a GPS clock, and for a mobile node, such as a notebook or a cellphone which has a GPS sensor, latitude and longitude will be calculated. These parameters of motion for the mobile nodes allows us to accurately calculate the link expiration time as long as the two devices remains connected. And By projecting latitude and longitude to a map, the position can be obtained. The data and the direction of the travel for the mobile node can be continuously received by a GPS receiver for the node. We assumed that two nodes are within their transmission ranges of each other, (x1,y1) is the coordinate of the first mobile node while (x2,y2) is the coordinates of the second. S1 and S2 are their speeds and θ1, θ2 (0≤θ,θ≤2Π) be directions of motion as shown in Fig (1). And link expiration time can be calculated using the below equation:

$$D_t = -(qw + as) + \sqrt{(q^{2+}a^2)\frac{r^2 - (qs - aw)^2}{(q^2 + s^2)}} \quad (1)$$

Where q=S1cosθ1-S2cosθ2, w=X1-X2, a=S1 sinθ1-S2 sinθ2 and s=y1-y2.

Now once a source transmits a packet request, this packet request adds direction, speed and location of the node. Once the source's next hop receives the request to calculate the expiration time of the link between the source and itself. If notice that the source node must append its own location information in order for its next hop to calculate the expiration time for the link [2].

3.2. Calculating the Path Bandwidth

The network model assumptions are as follows. The (MAC) sublayer in our designed model was implemented using the channel representation for CDMA-over-TDMA. As defined in Lin and Liu. The hidden terminal problems [3] can be solved also using CDMA. "the hidden terminal problem occurs when two nodes try to transmit to a common third node at the same time in that case a collision at this point will occur and it is a hidden terminal because one of the transmitted nodes is hidden respect to the other transmitted node because it is out of range and it is a problem due to the collision at the common node". [4]. A transmitter-based code assignment was used for data transmission to assign codes. [5].

3.3. Execution steps

mentioned earlier the six points concerning the QoS. Now according to the first five i will discuss the steps of the "EMQR" protocol. [6].

3.3.1 Route discovery

In the suggested protocol, all the nodes will monitor their neighbor's signals using the radio interface. The strength of the signal is by SR and the range of the transmission of any device is expressed as R. The EMQR protocol's signal strength threshold value is shown in Fig (2), node's threshold value, thr = SR-α, where 0≤ α ≤ R. if the received signal strength from a neighboring node is equal to or larger than thr value, the connecting link to the neighbor will be flagged as stable. Otherwise, the packet will be dropped. All the link state info. And the history of the link will be saved in the packet. [7]. Link-state information might be collected by the destination nodes from other QRREQ packets, different paths will be the route for all of these packets. For each bandwidth request, QRREQ packetsare sent. Each of the mentioned packets will have the responsibility to choose the path from source to a destination, then one of these path will be chosen to transmit the data based on best route utilization. QRREQ packet will have the following information.

(1) Packet type
(2) S: the address of the source node;
(3) D: the address of the destination node;
(4) Packet sequence number.
(5) Visited nodes history
(6) Free slots in time of the nodes.
(7) Bandwidth requirements.

(8) Location information.
(9) ETR: expiration time for the route.
As calculated using Eq. (1).

3.3.2. Reservation of the Route

In order to satisfy the requirements of bandwidth and also taking in consideration large bandwidth as a QoS request, the destination node will be responsible for the bandwidth calculation as well as the QoS of multi-path route. Also, an available slots will determine the bandwidth of the path. Considering the path (X, Y) ={X, B, C, M, Y}. the bandwidth available will be defined using the below formula:

$$path_{BW}(X,Y) = \min\{link_{BW}(X,B), link_{BW}(B,C), \dots\dots, link_{BW}(M,Y)\} \quad (2)$$

4. Establishing an Available Manet

To create a QoS guarantee environment in MANETS we need to focus on making the network available because availability reflects on all the other issues, for example from the definition of the quality of service we said it is about maintaining a certain level of performance. So, if any of the nodes become not available the performance will be affected in apart or in a whole. From this point of view, we discussed (EMQR) protocol as a solution to maintain high level of stability in transmission/routing ration through data transmission.
In that point we will suggest (WEAC) WARNING ENERGY AWARE CLUSTERHEAD as a solution to the availability as it is one of our QoS issues.

4.1. The Reason behind the Choice

As the first protocol fix the reliability issue for the links and guarantee a certain level of reliability with respect to the links, a question arises: what the next thing to do to guarantee the whole availability of the network? The obvious answer is to guarantee the availability of the nodes themselves, and the metric that will be used is the power level as the main metric for the nodes availability. For this reason, the WEAC protocol is suggested in order to fix that issue.

4.2. The Warning Energy Aware Clusterhead Protocol

This protocol will establish a dynamic wireless mobile ad-hoc infrastructure, infrastructure protocols that are cluster in nature, in this protocol the node is chosen from nominee's nodes to act as a base-station for some time within its zone. Prior to a previous study, the WEAC protocol scales very well for large networks of mobile stations and it also out performs other routing protocols in the context of load balancing, energy saving and stability , among other networks.
Another important issue relates to MANTEs, it may be considered as autonomous issue of mobile nodes. Some networks has a dynamic, sometimes rapidly changing multi-hop topologies, which are likely to be composed of relatively bandwidth limited wireless links.
Hence an efficient centralized mechanism should be devised, and created, by a standard body when it is needed. Intuitively this place an indispensable focus of the infrastructure – based communications or cluster-based for the mobile ad-hoc networks.

So designing an infrastructure based solution or protocol for infrastructure less is very important, as many ad-hoc problems will be solved that relate to the same issue [8].

for the suggested system the above criteria made a great benefit as the nodes "people" are of rapid movement and the data "calls" are transferred from one cell to another, making the infrastructure – like criteria an important aspect to consider.

from this perspective the WEAC protocol came to solve all the above issues with the react to topological change and load balancing.

4.3. Operation

In this scheme some of the mobile terminals (MTs) are chosen in order to take responsibility of all the MTs within their own transmission range, or a group of them. Every MT will acknowledge their own location using hello packet, they are referred to as beacon packets. The process of choosing a Cluster-head from a group of nominees relies on its power level "PL". MTs specification are as the following:
a) a Cluster head: a leader of the cluster, as it is named.
b) Zone_MTs: MTs are supervised by a Cluster head.
c) Free_MTs: MT that is neither Cluster head nor zone MT (not related to a Cluster head).
d) border or Gateway MT: that positions between the above, so it can be any one of them.
Every MT will have a "mych" variable an MT's "mych" variable will be set to the the Cluster head id. That said, if the mobile node itself is a Cluster head then its "mych" variable value will equal zero, else it will be set to -1 that will indicate that this node is a Cluster head of itself or it is a free node. A Cluster head will also collect complete status about other Cluster heads and their own list of MTs, and it will broadcast this status in its periodic "hello" messages.

4.4. Power level (PL) calculation technique

1. Mobile terminal PL ≥ THRESHOLD_1, a mobile node is willing to act as Cluster head and ready to acknowledge other nodes merge request if those mobile terminals have a lower PL. if both have the very same power level (it is practically not possible) then a node with a greater number of adjacent nodes will win. As shown in fig (4).

2. THRESHOLD_1 < MT's PL ≥ THRESHOLD_2, a mobile terminal will deny any merge request message that is requested from other nodes, if the node serves as a Cluster head then it will remain Cluster head but it will not add any more nodes to its list of supervision. As shown in fig (5) below.

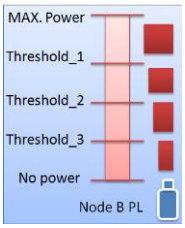


Fig.4: PL≥ THERESHOLD_1

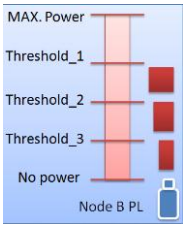


Fig.5: PL ≥THERESHOLD_2

3. THERESHOLD (2) = MPT PL ≥ THRESHOLD (3), if a node acts as Cluster head, it sets the value of its warning threshed flag to true, telling its zone MTs to search for a replacement Clusterhead. They are still allowed to remain until the threshold drain to THRESHOLD_3. As shown in fig (6).

4. Mobile terminal PL = THRESHOLD (3), the Cluster head mobile terminal will deny any request to merge and notify its zone MTs via message which is (iam_no_longer_your_ch) if it was serving other nodes. As shown in fig (7).
At all times however if the node's mych = (-1) it will send request to merge to the MT with the higher PL that equals to THRESHOLD_1.

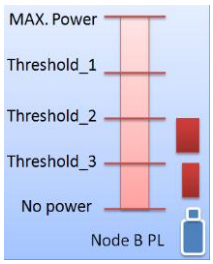


Fig.6: PL > THERESHOLD_3

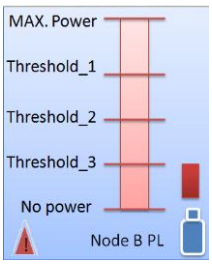


Fig.7: PL = THERESHOLD_3

5. Conclusion

I conclude from this study that to achieve a QoS guaranteed MA-NET we need to consider the most important QoS elements and acts accordingly, I combined two important aspects which are reliability and availability as an essential element to maintain a reliable, stable and available mobile ad-hoc network. In this frame of study, we also saw that both the suggested protocols are based on the term availability, by maintaining the nodes availability according to their power level by suggesting the WEAC protocol. And the reliability by increasing the reserved bandwidth for the route as mentioned in EMQR protocol.

6. Future Enhancements

Starting with the QoS issues in MANETS, all of the considerations was based on obtaining reliability, stability, and availability, but very few had dealt with the quality of the transmission itself as well as the security of the path and the nodes themselves. It is an important research to establish because the ad-hoc networks have vast of application and can be applied in multimedia communication.
A more emphasis is applied to the security of the links as it has a direct effect on the availability and integrity of the information transferred especially if the MANET was deployed in a military environment.

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