Evolution of Geographic Content Location Protocol (GCLP) for MANET

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ABSTRACT

Computer networking is undergoing through a revolution, there are many new techniques emerging in this revolution and ad-hoc network is one of them. Ad-hoc network is a self adjusting infrastructure less network with dynamic topology of mobile nodes. They are being established for a purpose of temporary period. When a node in network wants to transmits data to other node it sends update message (UM) over the whole network, when desired node receive the UM it then send back acknowledgement to source node after that transmission of data takes place. Here UM is sent throughout the network unnecessarily, it increases the power consumption and query rate of network. These are the major drawbacks of this network. To overcome this problem geographic content location protocol (GCLP) is used. GCLP makes use of location information to lower proactive traffic while minimizing query cost. It is based on directional trajectory of UM. It uses location information to achieve scalability and cost effectiveness as measured by distance between clients and discovered servers. In this paper we have given a brief idea about the implementation and working of GCLP.

Keywords

Update Message, Content Location Server, Content Server, iMesh, Query Message.

1. INTRODUCTION

Advances in wireless networking have set new paradigms in computing, including pervasive computing based on a largescale wireless network. A mobile ad-hoc network(MANET) can be articulated as the self-configuring network of mobile devices termed as nodes and connected through a wireless link Ad-hoc is a Latin word which means 'for this purpose'. Such networks may be derived either by themselves or may be connected to the larger internet. The primary confront in building a MANET is equipping each device to continuously maintain the information required to properly route the traffic and also to efficiently locate not only the general purpose resources but also the specific services available on the network.

Service location in wireless networks is a challenging problem for several reasons. Firstly, due to lack of infrastructure, there are no well-known servers in a pre-defined network structure. Second energy scarcity in a network node in a wireless network necessitates the design of new service location protocols that are qualitatively from those designed for wired network.

Third, in many cases, wireless networks may scale up to thousands of nodes, rendering the content location problem even more challenging. For instance Printers and fax machines are a common requirement for various applications and are presumed as accessible to manifold users in a network. In a certain wireless network, where multiple users are connected in a network, the user may not always be likely to know the location and behavior of the resource for his utilization. To deal with this trouble, a variety of algorithms have been presented to solve the problem of resource location in ad-hoc networks. Some of the approaches were like as Service Location Protocol (SLP) version 2. But all these models have a common reliability upon a centralized storage that would handle queries by the users. This reliability feature of the above mentioned approaches violates the basic constraint of the ad-hoc network which signifies that all the nodes in the network should be considered equal and none of them should be given the extra responsibility when compared to its nobles. To overcome the above depicted approaches, decentralized storage based models were developed such as G2:P2P which surely avoided the reliability on the centralized directory server and removing the bottle-neck and single point of failure that centralized systems suffered from but they further lacked in accounting the link cost when computing the routes in the network. This resulted in making them as an impractical means for the ad-hoc networks.



Figure1. Centralized storage approach

Later on, some of the explorers proposed the role of content location information for routing. The protocols developed on the location basis were designed to periodically send the content advertisement through the geometric trajectories and cross-shaped trajectories. The advertisement was supposed to be done by the content servers in the network. Conversely, it was perceived that as the number of content servers grows, the amount of proactive traffic becomes exorbitant since these protocols assume that each node will advertise a unique resource or content. That was not veritable as duplicate resources may well exist in the network. An instance of this duplicity can be several replicas of a file hosted by different servers or an identical services provided by multiple nodes in the network. Under such conditions there emerged a need for developing a better location based protocol which could scale well by considering the attempts to limit the overhead for duplicate contents or resources. Presenting and demonstrating such an efficient protocol which could provide a firm level of scalability is the involvement of this research. Thus we are presenting a content location service, Geographic-based Content Location Based Protocol (GCLP).



Figure2. Decentralized storage approach

Geographic Content Location Protocol (GCLP) has emerged as the recently developed geo-casting based protocol for the role of service discovery in Mobile Ad-hoc Network (MANET). This protocol implements the physical location information of the contents or requested resources to lower the amount of proactive traffic. GCLP is designed on the floor of Geo-Casting where information is delivered to a group of nodes in a network identified by their geographical locations.

2. SUPPOSITIONS FOR GCLP

- The network which is considered for utilising the GCLP must not have a static topology.
- GCLP is supported by the postulation that source sends a update message(UM) to the geographical location of the destination content or resource instead of using the network address.
- Next assumption for GCLP requires that each node in the network can determine its own location information and also the source is aware of the location of content or resource.
- To locate a specific content, a device in the network needs not to be aware of all the resources on the network.
- In case when a node requires content, then the node only requires contacting to one of the several nodes in the network which is advertising the information about the contents they are hosting.
- The protocol treats all the nodes in the as equal and neither of the nodes is endorsed to take more responsibility than others.

Though we attempt to operate in an environment where communication cost is high, we also want queries to be relatively cheap while still allowing for lower overhead cost and scalability of the protocol.

3. GEOGRAPHIC - BASED CONTENT LOCATION PROTOCOL (GCLP)

GCLP can presume as a concrete requirement for the establishment of the mobile ad-hoc network with efficient and low cost resource utilization'. We are initiating the topic by giving a brief overview of the protocol.

3.1 General Scheme

GCLP provides its simple attempt to provide the resources that are situated in the network to the various nodes throughout the network on the basis of their geographical location in the network. In GCLP various nodes are presumed to play various roles according to their requirements and their working conditions. Some of them use to work as the servers to provide the resource throughout the network while others are expected to be the clients of those contents. This provides us the information of about three major entities in the network. Firstly, a Content Server (CS) is the node which host one or more contents that may be requested and used by the other nodes in the network. Secondly, a Content Location Server (CLS) are the nodes which host the location information about the one or more resources available in the network. The CLS's are obliged with duty to provide timely and periodic information about the contents in return of the queries generated by the other nodes in the network. Thirdly, Clients which are the nodes responsible to generate the queries regarding to various contents required and available in the network. The CLS in the network are selected by choosing the closest node to the trajectory and line also the distance between the two consecutive CLS should be enough to avoid the congestion in the network.



Figure3. UM's sent by Content server

As illustrated in figure 3.1, after each predefined interval. Content Servers (CS) issues update message (UM) to the specific nodes in the network along the four opposite geographic directions or trajectories. These messages include the information about the resources available and the servers which are hosting them in the network. The Content Location Servers (CLS) are also situated on the same trajectories through which the update messages have being sent. The work of these CLS's is to cache the information from these UM's and in case they have received any query related to the content and the Content Server, it replies to the Client node with the Content Server address. The CLS's then uses the algorithm for selection of next hop node to decide which node will be the next CLS. This continues until the node on the edge of the path realise that there no more further nodes in the selected trajectory path. The functioning of the Client is to locate any content on the network by generating the Query Messages(QM) towards the CLS's which propagate along the same pre-defined trajectory path used by the UM's.

The QM's always acquire a forwarding scheme that maintain their traversing cost low while searching for the requested content information. To make sure that all the Client nodes in the network are aware of their neighboring nodes and another type of message is also used by the nodes termed as the HELLO message. This HELLO message assists in selecting the next hop hosts for update and queries messages and thus broadcasted by each node in the network towards their neighbor nodes to clarify node's position. Throughout the whole network, CLS plays a vital role for providing the information about the location of the required resource for the client node. HELLO messages help the client nodes to be This basic advertising phenomenon is demonstrated in the figure 3.2.Here, update messages have been shown traversing in the network along the four directions for the Content Location Servers (CLS's) which are named here as Response directories. The client nodes uses the traversing path shown in the figure 3.2 as discovery path request and receive the needed content by contacting to these response directories which in turn provide location



Figure 4. Architecture of network with several content servers

One of the major event during the protocol working is the selection of the CLS nodes along the geographic direction of the UM's. For the selection of an optimal CLS node following tactics may be applied:

- Hire the node in the network which is closer to the trajectory path along which the UM is traversed. This attempt maintain a straighter path of the CLS but it may be sometimes less efficient as some of the CLS may be closer to each other in larger extent even if nodes are placed farther away in the sector of the Content Server.
- Else select the nodes with the greatest distance from the current node. This selection may increase the efficiency as it provide with larger distances between the CLS but this approach results in the broadcasting trajectories that are not straight.
- A blend of both approaches.

The authors of [3] have suggested choosing the first two CLS selection methods. We modify this basic selection algorithm as follows. We would like to achieve two main motives for

the selection of next hop CLS-cover a larger distance between the CLS's and to maintain a straight update trajectory path. To achieve these two motives each node in the 900 sector along the trajectory is assigned a rating based on equation (2), where R is the rating for the considered node in the sector, d is the distance from the node making the decision, r is the offset from the geographical directional line and p is distance on the geographical directional line between the point of intersection of perpendicular from the considered node and the node making the decision. Now firstly by applying the Pythagoras theorem we get the value of for each available candidate node for CLS, Now for obtaining the rating value for each node in the sector, This is further clarified in figure below.

$$p = (d^2 + r^{2)1/2}$$
(1)

$$\mathbf{R} = \mathbf{p}/\mathbf{r} \tag{2}$$



Figure 5. A node picks the next hop for an update message among nodes in the appropriate sector.

A node N is considering three available candidates for the appointment of next hop CLS namely A, B, C. By applying the above derivation in equation (2), node B will be selected as the next hop CLS since it achieve the highest rating. The selection of sector with 900 angle is justified with the reason to provide more number of nodes for the selection process.

3.2 Role of Client Node

The client nodes in the ad-hoc network are spontaneously spread in the network. There major role in context of GCLP is to locate the desired resource for their use by sending the request messages to the servers. To situate the content in the network, the client nodes will also follow the same algorithm as described above in section 3.1. The content discovery process is defined in the figure 3.4. The client node initiates its role by sending the query message throughout the network using the same four-directional trajectory path after receiving the UM's from its closest CLS. When these QM's are received by the CLS in the network, they react to it by sending the response messages back to the client node. If there is a situation in which a client node which has forwarded the QM may receive multiple response messages in return from all those CLS which acquire the location information of the resource which is required the client node. Under this condition the client node selects the optimal CS which is closest to the trajectory path. Client node is constrained to request for the desired content only to those CLS which are covered up in its sector. It cannot send any query or request messages to the CLS outside its sector to avoid the condition of unusual congestion and interference in the path of other trajectories.



Figure6. Client sending the response messages using the same trajectory path to the content location server.

4. EVALUATION OF GCLP

During the working of GCLP in the network, the update paths established by Content Servers (CS) are promoted by the CLS closest to the path. But, a CLS receiving the UM from one CS may also acquire the updates from any other CS if it falls closest to the trajectory path of any other CS in network. Thus, there exist conditions under which two or more CS's may interrupt each other's trajectory path through a common CLS being used. Under such circumstances the update trajectory of any one of the CS will be suspended and the CLS will propagate the UM of any one of the CS. Now we have to evidence that under these conditions there will exist at least one of the update trajectory path which will traverse in each of the four directions. Our next attempt is to attest the existence of at least one update trajectory in case of trajectory path interruption.

4.1 Evidence of Accuracy

The CLS in the ad-hoc network is set to forward the UM's and provide the content location information for at most any one CS in the network. In the GCLP based ad-hoc network if in any condition a CLS is situated in the trajectory path of two or more CS, it can forward the UM's of any one of them in the network. Thus, it will suspend the UM projection of the other CS's. Thus we have to be sure that under this critical condition, the network still consist of at least one trajectory path which is reaching in all the four geographical directions in the network. To justify that that at least one contact of the query trajectory and the update trajectory exist even if some trajectories have been interrupting by the update paths of other closer CS, we need to proof that there is still at least on update trajectory that is still traversing in each of the four directions. For this confirmation kindly consider the below drawn figure 4.1.



Figure7. At least one trajectory will propagate in the direction of an interrupted update trajectory.

In the figure 4.1 we have illustrated two CS, say S1, S2 and two CLS namely Cl1, Cl2. The trajectory path of both of the CS's is shown in the form of the perpendicular lines which are in contact with each other's trajectory path on the points Cl1 and Cl2 which are the Content Location Servers(CLS). As it is clearly visible from the diagram that both S1 and S2's trajectory path are crossing each other's way at the point where both CLS, Cl1 and Cl2 are situated .Now due to the constraints over the CLS, it can forward and response to the query for any one of the CS i.e. either for S1 or for S2 because if it is allowed to forward the messages for more than one CS it may create worst condition in the network of ambiguity and duplicity. Thus, the CLS which is common between the trajectory line of two or more CS will interrupt the message forwarding of all the rest CS and will be allowed to send and receive the update and query message for at most any one of those CS. Now, even if the update trajectory of any one of the server, let us say S1 is suspended by the CLS, but it will still propagate the update trajectory for the other one i.e. S2. This would lead to the existence of at least one of the update path that is traversing in all four directions in the network. For this reason we can establish the fact that, even in the case of interruption, at least one update and query trajectory covers the way in each of the four directions in the network and thus prove the accuracy and correctness of the protocol.

4.2 Generalization of Gclp

GCLP provides an effective scalability and low routing cost in the network but still there was a need to minimize the overhead in the network due to large amount of update messages and query messages generation by several server nodes and the client nodes. Thus, to make a significant improvement in the performance of distance sensitivity of GCLP and to avoid message advertisement overhead, GCLP was enhanced in the form of iMesh-A which is the generalization of GCLP. This extended form of GCLP makes the use of blocking rule [1] alone to build up the service directory i.e. information mesh. Though, there was a major requirement of a distance-sensitive service directory algorithm to guarantee nearby service selection. So to make a more compatible algorithm for Dirty-Pass case[2] and Isolation case[2], the complete version of generalized form of GCLP, which is iMesh-B was developed that uses both the blocking rule[1] as well as the extension rule[2]. As a result the generalized form of GCLP i.e. iMesh-B emerged as a more efficient form of the protocol which remove its message overhead situation and makes the GCLP an optimal solution for the use in mobile ad-hoc network.

5. CONCLUSION AND FUTURE SCOPE

In this review paper a brief idea of implementation of GCLP is given. GCLP works on the bases of directional trajectory paths to send UM's. Here source node sends the UM to CLS which are closest to trajectory path and having the larger distance between them to make the trajectory path as straight as possible. The client nodes utilize the same trajectory path to send back the response messages to only those CLS whose associated source node is closest that client node and hence it improves the scalability and traversing cost of the ad-hoc network. GCLP has shown the best result in the dense network in which the algorithm can find out more number of nodes to choose the CLS and client nodes for its operation. Certainly, there is a possibility that some of the new enhancements can be introduced in the protocol in the future coming ahead, like as the client nodes can be modified to select the CLS in other sectors without interrupting the trajectory path of any other CS. Beside this, there is also a possibility for a inclusion of some other factors in the solution which we have provided for making the selection of the closest and larger distanced CLS in equation (2).

According to our review paper GCLP has emerged as a firm support for MANET. This protocol is a viable and efficient geographic location-based way to sort out the problem of providing the contents to several nodes in the network with lower overhead of traversing throughout the network. Quorum based techniques can also achieve higher level of energy efficiency by aggregating the advertisements at each node prior to transmission. As we know, new changes and revolutions in the existing technology is the basic behaviour of the technology world, thus there exist a possibility that any technical revolution in future may challenge its optimality. Although GCLP is great achievement for the mobile ad-hoc network.

6. REFERENCE

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