

# **Independent Robust Mesh for Mobile Adhoc Networks**

B.Sujatha

Assistant Professor, Department of ECE, S V College of Engineering, Tirupati, A.P, India

**ABSTRACT:** Mobile ad hoc networks (MANETs) are continuously self-organizing, infrastructure-less consisting of collection of mobile nodes that communicate with each other without the use of centralized authority. MANETs are perfect for positions where a fixed structure is infeasible. Today's MANETs, suffer from network partitioning. This restriction makes MANETs inappropriate for applications such as crisis management and battleground communication, in which team members must work in groups spread in the application terrain. In such applications, intergroup communication is crucial to the teamwork. To address this fault, we present a class of network called Autonomous Mobile Mesh Network (AMMNET). Unlike conventional mesh networks, the mobile mesh nodes of an AMMNET are capable of following the mesh clients in the application terrain, and organizing themselves into a suitable network topology to ensure good connectivity for both intra- and intergroup communications. We propose a distributed client tracking solution to deal with the dynamic nature of client mobility, and present techniques for dynamic topology adaptation in accordance with the mobility pattern of the clients. Our simulation results indicate that AMMNET is robust against network partitioning and capable of providing high relay throughput for the mobile clients. This property makes AMMNET a highly robust MANET.

**KEYWORDS:** Mobile mesh network, client tracking, dynamic topology deployment, network partitioning.

## **I. INTRODUCTION**

Wireless technology has been one of the most transforming and empowering technologies in recent years. In particular, mobile ad hoc networks (MANETs) are most famous among network technologies. In such an background, no communication structure is required. The mobile nodes sometimes carry out the behaviour of routers, helping to forward data packets via multiple-hop relay to their destinations. They also cost operative solution because same ad hoc network can be repositioned and reprocessed in different places for different applications at different times. One great challenge in designing robust MANETs is to minimize network partitions. As autonomous mobile users move about in a MANET, the network topology may change unpredictably over time and portions of network become partitioned. This condition is undesirable, particularly for mission critical-applications such as crisis management and battleground communications. We address this challenging problem in this paper by proposing AMMNET. The proposed AMMNET has the following additional advantage. The mobility of the mesh clients is confined to the fixed area serviced by a standard wireless mesh network due to the stationary mesh nodes. In contrast, an AMMNET is a wireless mesh network with autonomous mobile mesh nodes. In addition to the standard routing and relay functionality, these mobile mesh nodes move with their mesh clients, and have the intelligence to dynamically adapt the network topology to provide optimal service. In particular, an AMMNET tries to prevent network partitioning to ensure connectivity for all its users. This property makes AMMNET a highly robust MANET. Our challenges in designing the proposed AMMNET are twofold. First, the mesh clients do not have knowledge of their locations making it difficult for the mobile mesh nodes to synthesize a global map of the user locations. Second, the topology adaptation needs to be based on a highly efficient distributed computing technique to keep up with the dynamic movement of the mobile users.

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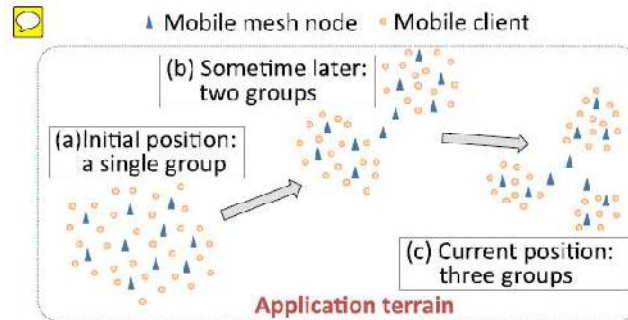


Figure 1: Topology adaptation of the autonomous mobile mesh network under three scenarios.

The topology adaptation of an AMMNET is illustrated in Figure 1. The mesh clients initially concentrate in one group. All the mesh nodes position themselves within the same proximity to support communications inside the group. Fig. 1(b): The mesh clients move northwards and split into two groups. The mobile mesh nodes, in this case, reorganize themselves into a new topology not only to facilitate intragroup communications, but also to support inter-group communications effectively preventing a network partition. Fig. 1(c): The same mesh clients now move southeast and form three groups. The mobile mesh nodes adapt their topology accordingly to archive full connectivity for all the mesh clients. Delay Tolerant Network (DTN) is other option to support opportunistic communications for mobile networks. We note that if the number of mesh nodes in AMMNET is not enough to support full connectivity for the entire terrain, DTN can be used to improve the probability of data delivery. We leave the integration of AMMNET and DTN as our future study. We assume that each mobile mesh node is equipped with a localization device such as GPS. In addition, a mobile mesh node can detect mesh clients within its sensing range, but does not know their exact locations. For instance, this can be achieved by detecting beacon messages transmitted from the clients. Alternatively, RFID has been proposed for location-based applications [4]. Similarly, mesh clients can be tagged with an inexpensive RFID and mobile mesh nodes are equipped with an RFID reader to detect the presence of mobile nodes within their sensing range.

## II. RELATED WORK

In ad hoc networks, [2] all the nodes are assumed to be movable and there is no fixed structure for the network. These networks find applications where fixed infrastructure, such as military operations in the battleground, emergency operations, and networks of handheld devices. Because of absence of infrastructure network formed by collaboration of nodes done among themselves. Due to mobility of the nodes in the network, the network topology changes frequently. These frequently changing topologies are handled by ad hoc network protocols. In most of the applications of ad hoc networks, the mobile devices are energy constrained as they are operating on battery. This requires energy-efficient networking solutions for ad hoc networks. In [3], it measures distance between nodes and uses that range information to estimate location of client. This estimated value is not appropriate. Some range free localization schemes, only use node connectivity and hop count information to estimate node locations without explicitly measuring every link distance.

Our work on router deployment is also related to recent work on sensor covering in a stationary sensor network [4], [5]. These schemes ensure that each point in a target field is in the interior of at least  $k$  different sensors. Several work [6], [7], further takes energy efficiency into account, and assigns each sensor a sleep-active schedule to guarantee sensor cover and, at the same time, prolong the lifetime of a sensor network. More recently, some work exploits sensor mobility to improve the performance of sensor covering. A self-deployment protocol is proposed in [8] to enable randomly scattered sensors to automatically move to the target planned positions. Instead of deploying stationary sensor nodes to cover the entire monitoring field, an alternative is proposed in [9] [10] to use *mobile mules* to move around different monitoring areas and gather data along the traversed paths. All the above studies focus on deploying sensor nodes to monitor a given target area. Our work differs from the sensor coverage schemes in that it builds a

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dynamic mesh infrastructure for mobile clients that have unpredictable moving patterns and move around a non-predefined application terrain. Due to mobility of nodes, nodes are dislocating to each other. In existing system, no tracking of nodes, it just identifies the nodes. No updating of routing table. Before sending any data, it not confirms the availability of nodes. It just send the data without confirming the availability of nodes which will result in network failure.

## III. PROPOSED METHOD

We present a mobile infrastructure called AMMNET (Autonomous Mobile Mesh Network). When the user groups move apart, these users group are tracked by mobile mesh router of AMMNET and dynamically adapt the network topology to seamlessly support both their intra-group and intergroup communications. Since this mobile infrastructure follows the users, full connectivity can be achieved without the need and high cost of providing network coverage for entire application landscape at all time as in old-style stationary infrastructure. In contrast, an AMMNET is a wireless mesh network with autonomous mobile mesh nodes. In addition to the standard routing and relay functionality, these mobile mesh nodes move with their mesh clients, and have the intelligence to dynamically adapt the network topology to provide optimal service.

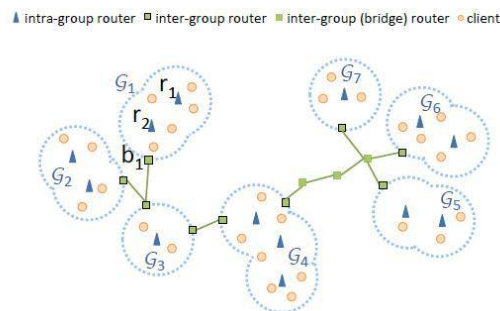


Figure 2: Routers partitioned into two groups. Intra-group and intergroup routers prevent network partition in AMMNET.

Initially network initialization occurs, where area 300\*300 area with 50 nodes, initial energy of node is 100J. Then cluster formed using K-medoids algorithm. Totally seven clusters occurred named as G1, G2, G3, G4, G5, G6, G7 as shown in Figure 2. Nodes only sometimes behave as routers. Routers partitioned into two groups i.e., intra-group and intergroup. Intra-group router that monitors the same group of clients can communicate with each other via multihop routing. For example, routers r1 and r2 in Figure 2 are intra-group routers that monitor group G1. Intergroup router is also mesh nodes i.e. square nodes in Fig2, if it plays the role of relay node helping to interconnect different groups. For each group, at least one intergroup router that can communicate with any intra-group routers of that group via multihop forwarding as bridge router, for example, router b1 for group G1. Free routers are the third type of mobile mesh nodes, if it is neither an intra-group router nor an intergroup router shown in Fig3

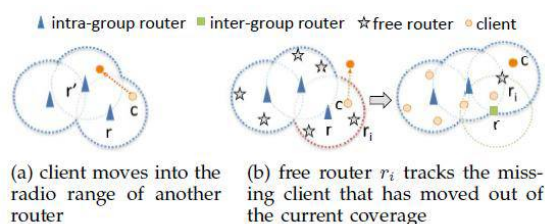


Figure 3: Tracking the clients

Each client broadcasts beacon message to notify its presence within the radio range of an intra-group router. When this router no longer hears the beacon messages, one of the possible scenarios might have happened. The first scenario is

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illustrated in Fig. 3(a). It shows that client *c* moves out of the communication range of router *r* into the communication range of an adjacent router *r'* in the same group. The second scenario is illustrated in Fig. 3(b). It shows that the missing client *c* moves from the communication range of router *r* to a space not currently covered by any of the routers in the group. The router *r* can distinguish the above two scenarios by querying its neighbouring routers for their lists of monitored clients. The router distinguish above two scenarios by querying its neighbouring routers for their lists of monitored clients. If *c* is in any of these lists then first scenario occurs otherwise second scenario occurred[1].

If the client moves from one router area to another router area as in Fig.3 (a),no action is required. If client moves out of the current network coverage area as in Fig.3 (b),free routers are triggered to track the missing clients. To achieve this goal, once router *r* detects the missing client, it broadcasts a message to trigger the neighbouring free routers to track the missing client *c*. Specifically, since client *c* moves out from the radio range of router *r*, a free router must be able to locate the client *c* by navigating the boundary of *r*'s coverage, which is the circle centred at *r*, i.e., the red segment shown in Fig. 3(b). Once a free router detects the missing client, it then stops navigating and switches its mode to become an intra-group router. We note that this new intra-group router will have connectivity to the rest of the intra-group routers because it is within the radio range of the original monitoring router *r*. We evaluate the forwarding latency in terms of the number of relay hops required to forward packet. Since each link is terminated at a router or gateway, the processing performed within the device to determine how to forward the packet adds overhead to the transmission.

## IV. RESULTS

We conduct extensive simulations, implemented via MATLAB, to study the ability of AMMNET in adapting to the dynamic movement of mobile clients and the data forwarding efficiency of such networks. As shown in figure 4, proposed system able to cover all clients. When compared with existing system, the hop count reduced that leads to increase in performance and life time also increased.

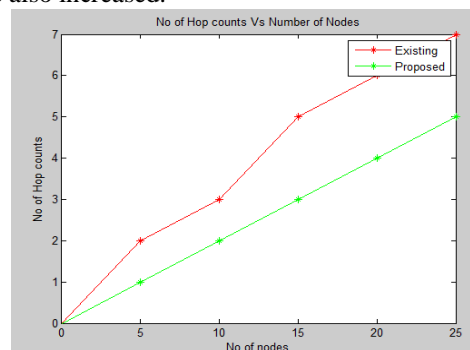


Figure 4: Number of Hop count Vs Number of nodes

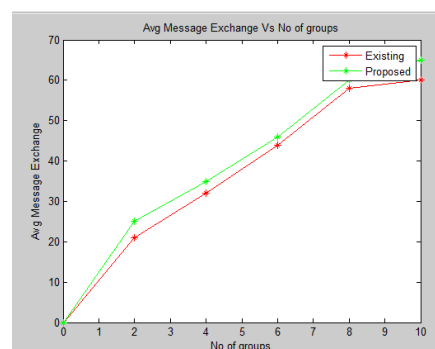


Figure 5: Average Message Exchange Vs Number of groups

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As shown in figure 5, average message exchange tells indirectly the availability of nodes. As number of group increases average message exchange increases, i.e., the number of intergroup routers along the bridging network. To perform network adaptations, a node needs to collect location information of the bridge routers, and multicast the assigned locations to the selected inter-group routers. In this study, we evaluate the number of exchanged messages required for such an adaptation process. AMMNET takes advantage of data forwarding opportunities to collect partial location information. It incurs only a few message overheads in collecting the location information for the computation of the assignment list. However it helps in building a topology that provides a coverage and throughput performance. Throughput means how many packets are sent in given amount of time. Throughput increases the network performance. The throughputs of all the other schemes are measured for the entire duration of the simulation to evaluate how they are affected by dynamic topology and route reconfiguration.

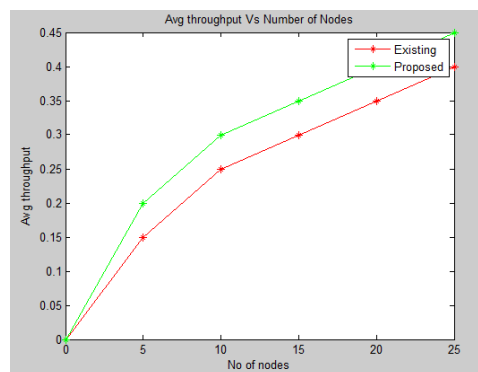


Figure 6: Average throughput Vs Number of nodes

Figure 6 that the average throughput obtained in AMMNET(proposed system) is about 33% higher than that in the existing system. This is due to the fact that some sourcedestination pairs in the grid-based mesh are not served by any routers and data could not be delivered. AMMNET can achieve a throughput about 70% of that of the existing because in existing it only identify the missed and not track it as in the proposed AMMNET. The performance gap comes from the slightly longer relay paths, and, more deterministically, the packet loss due to route reconfiguration. More specifically, when mesh nodes adapt their locations to client movements, each router cannot relay data along the previous relay paths and needs to discover new routes. Some packets buffered in the original routing paths might be dropped, resulting in throughput degradation. Moreover, the throughput of MANET is far lower than that of AMMNET. This is to be expected because, when the network is partitioned into multiple groups, a MANET source destination pair might not be able to find a path to communicate with each other when they belong to two partitioned groups, as a result leading to a zero throughput. This situation is quite common in a dynamic environment, where users are highly mobile in a large application terrain.

## V.CONCLUSION

For applications such as crisis management and battlefield communications, the mobile users need to work in group dynamically in indeterminate application terrain at different times. There is currently no cost effective solution for such applications. Since the user groups occupy only a small portion of the terrain at any one time, it is not acceptable to deploy an expensive infrastructure to provide network coverage for the entire application landscape at all period. Other challenges are due to the potentially hostile environment and the uncertainty in how the application terrain unfolding with time. In this paper, we introduce a new class of AMMNET. Unlike conventional MANETs that suffer network partitions the mobile users move apart to different locations, mesh router of AMMNET track the users and adapt network topology dynamically to support both their intragroup and inter-group communications. We conducted extensive simulation study to assess the effectiveness of AMMNET. The results confirm that the proposed distributed topology adaptation scheme is effective with complete knowledge of the locations of the mobile clients. The simulation results also indicate that AMMNET is scalable with the number of users. As number of group increases, average message exchange also increased, which identifies the availability of nodes. But in existing system even though no

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Vol. 4, Issue 11, November 2015

availability of nodes, then also it send message led to the problem. The required number of mobile mesh nodes does not increase with increases in the user population. Although an excessively large number of user groups may affect the performance of AMMNET, the number of user groups is typically very small relative to the number of users for most applications and AMMNET is effective for most practical scenarios. There are still many interesting issues not yet examined in our study such as searching for disappearing mobile clients, minimizing routing paths, and utilizing nonoverlapping channels. We leave these changes for future research.

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