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Spectrum Sharing Scheme to Minimize Overlapping Channels in AMMNET

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***Abstract*— Autonomous Mobile Mesh Network (AMMNET) is a new class of Mobile Ad-hoc Network (MANET), which will not undergo network partitioning like MANET. AMMNET are used in crisis management and battlefield communication, where team members will work in group scattered in application terrain. Unlike conventional mesh networks, the mobile mesh nodes of an AMMNET are capable of following the mobile clients in the application terrain, and they form different network topology to ensure good connectivity for both intra-group and inter-group communications. But the interference is the problem occurred due to overlapping channels. This problem is addressed by introducing dynamic spectrum access protocol in which client-to-client users can communicate directly with each other using the same frequency resources as simultaneously active uplink between a mobile client and mesh nodes is established. This protocol is opportunistic as a link between two clients can only be utilized with their use of the spectrum stays within the interference temperature of the network. This also reduces overhead of intra-group routing in mesh nodes.**

***Index Words*— Autonomous Mobile Mesh Network, Mobile Ad-hoc Network, mobile clients, mesh nodes, dynamic spectrum.**

I. INTRODUCTION

Wireless communication technology is one of the most changing and enabling technologies. Mobile Ad Hoc NETwork (MANETs) is one of the popular wireless communication technologies. In this MANET there is no pre-constructed infrastructure for communication, such a network does not require any infrastructure for communication. Mobile nodes help to forward data packets from source to destination node using multiple-hop relay, and acts as routers. Hence MANET is suitable where no fixed infrastructure is available or infeasible. The ad hoc network can be reused for different applications by relocating network in different places at different time and so it is cost effective.

MANET is formed by number of nodes, which are dynamic in nature. The dynamic nature of nodes makes routing very difficult, and leads to breakup of routes frequently which affects network connectivity. This makes MANET to undergo network partitioning. This limitation makes MANET infeasible where team members need to work in groups such as battlefield communication and crisis management. An Autonomous Mobile Mesh Network (AMMNET) is a network which contains mobile clients and mesh node. The wireless mesh nodes contain multiple radios in single node which helps to handle multiple frequency bands. These mesh nodes also have mobility, unlike regular mesh network. Mobile mesh nodes in AMMNET move along with mobile clients in application terrine, and construct network topology and helps mobile clients to communicate. When mobile clients move in application terrine mobile client tracking algorithm is adopted to track the mobile client by mesh node with respect to mobility of clients.

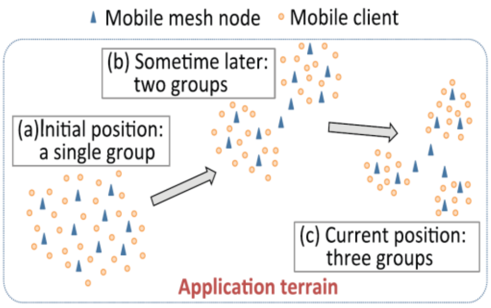

Fig. 1. Representation of Autonomous Mobile Mesh Network (AMMNET)

AMMNET contains mobile clients and mobile mesh node in one group. When mobile clients start moving mesh clients also move along with mobile clients (fig1a). The node of AMMNET split into groups (fig1b) with time and forms two are more intra-groups. The mesh nodes adapt network topology to form connectivity between all mobile clients (fig1c) and make inter-groups communicate.

Mobile clients in AMMNET suffer from overlapping channel [1] in communication. Missing of client node is the main problem arises in this type of network. The location of each mobile mesh node is given with a GPS and then the mesh node can find the location of mobile client within its sensing range. RFID [5] is another way for finding the location of nodes. If mobile mesh nodes are given with RFID reader to detect the mobile client. Dynamic spectrum access protocol is a technique [2] which is used to assign different bandwidth to different nodes within the range of bandwidth available. This make frequency resources as simultaneously active uplink between a mobile client and mesh nodes is established.

The mesh nodes in AMMNET will act as routes also hence in this paper mesh nodes are also referred as routers. Ad hoc On-Demand Distance Vector Protocol (AODV) routing protocol which is used in forwarding data in MANET is only used to transmit data in AMMNET. Any other protocols used in MANNET for data transmission can be used since the routers are not fixed in a single location.

II. EXISTING SYSTEMS

AMMNET is a new class of network where mobile clients are robust against network partitioning. The mobile mesh nodes provide the routing and relay of data to the mobile clients of AMMNET, by this mesh nodes the mobile clients can communicate. The mobile clients send data directly to the mesh nodes. These mesh nodes are used as routers and transmits data to the destination.

The mesh node not only acts as router but the main job of mesh node is to track the mobile client and find location. This makes the mesh node to drain its battery power. If mesh node fails its can be replaced by new one and the mesh network will recognize and reconfigure new mesh node automatically.

If the mobile clients in application terrine increases with time but number of mesh nodes will not increase, it forms overhead on the mesh nodes to track all the mobile clients. If the mobile client disappears then the mesh node has no ability to search the missing client. The AMMNET as number of mobile nodes, while transition of data they suffer from overlapping of channels.

A. Disadvantages

- Overlapping of channels.
- Number of mesh nodes will not increase with increase of mobile clients.
- Mesh nodes are not capable of missing mobile clients.

III. PROPOSED SYSTEM

AMMNET contains mobile clients and mesh nodes where mesh nodes are used for tracking of mobile clients and forwarding data for mobile clients of which are in the different groups. Since mobile nodes suffer from channel overlapping, Dynamic Spectrum Access protocol is proposed, were client to client data forwarding is done by sharing different bandwidth frequencies between all the client in available range of bandwidth dynamically.

Dynamic Spectrum Access protocol is used to minimize the overlapping of channels, mobile client are assigned with different bandwidth within the range of mesh node to which it is connected to. By this client-to-client users can communicate directly with each other using the same frequency resources as simultaneously active uplink between a mobile client and mesh nodes is established. This protocol is opportunistic as a link between two clients can only be utilized with their use of the spectrum stays within the interference temperature of the network. This also reduces overhead of intra-group routing in mesh nodes.

The mobile clients share different bandwidth and within intra-group forwarding of data between mobile clients are done without interaction of mesh node. Where as to communicate with the mobile client of inter-group client, mobile client request mesh node to route data to inter-group. This reduces the overhead at mesh node. The power consumption of the mesh node is reduced because of reduction of data forwarding in intra-group.

A. Advantages

- Achieves performance superior to existing protocols in terms of energy efficiency, packet delivery ratio (PDR), and latency.
- The mobile mesh nodes adapt their topology accordingly to archive full connectivity for all the mesh clients.
- A mobile client tracking solution to deal with the dynamic nature of client mobility.
- An AMMNET tries to prevent network partitioning to ensure connectivity for all its users. This property makes AMMNET a highly robust MANET.
- Eliminates overlapping channels.
- Reduce overhead of mesh node.
- Minimizes delay and increases through put.
- Minimizes power consumption in mesh nodes.

IV. OVERVIEW OF NETWORK

AMMNET is a network made up of mobile clients and mobile mesh node, where mobile clients are users and mobile mesh nodes are the one used to track the mobile clients. The mobile mesh nodes are called as mesh nodes and routers (intra-group routers, inter-group routers and free routers). Since both the type of node move in group, AMMNET is called as group mobility model.

The mobile mesh nodes according to its role can be classified as following.

A. Intra-group router

If a mesh node has at least one mobile client within the radio frequency range of mesh node, which helps to route the clients data from one router to another router within the group is called intra-group router. Mesh node in Fig. 2 act as intra-group router.

B. Inter-group router

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If the mesh node is inside a group (Fig. 2) and helps to forward mobile clients data from its group to destination in other group then it is called as intra-group routers.

C. Free routers

The mesh nodes without any mobile client within its range (Fig. 2) and helps to route data from inter-group router to other inter-group router is called free router.

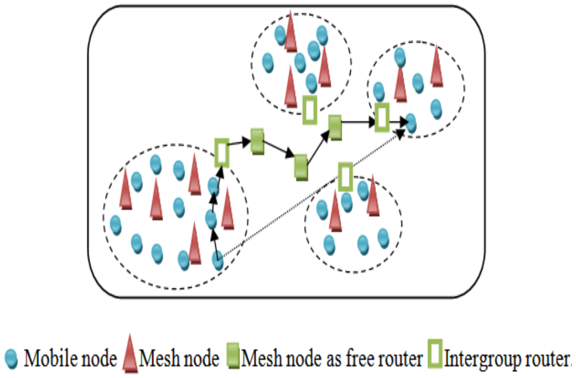


Fig. 2. Overview of AMMNET

V. SYSTEM DESIGN

An AMMNET is a mesh-based infrastructure that forwards data for mobile clients. A client can connect to any nearby mesh node, which helps relay data to the destination mesh node via multihop forwarding. Like stationary wireless mesh networks, where routers are deployed in fixed locations, routers in an AMMNET can forward data for mobile clients along the routing paths built by any existing ad hoc routing protocols, for example, AODV. Unlike stationary wireless mesh networks, where routers are deployed at fixed locations, routers in an AMMNET are mobile platforms with autonomous movement capability. They are equipped with positioning devices such as GPS, to provide navigational aid while tracking mobile clients. Clients are not required to know their locations, and only need to periodically probe beacon messages. Once mesh nodes receive the beacon messages, they can detect the clients within its transmission range. With this capability, mesh nodes can continuously monitor the mobility pattern of the clients, and move with them to provide them seamless connectivity. Mesh nodes can exchange information, such as their locations and the list of detected clients, with their neighboring mesh nodes.

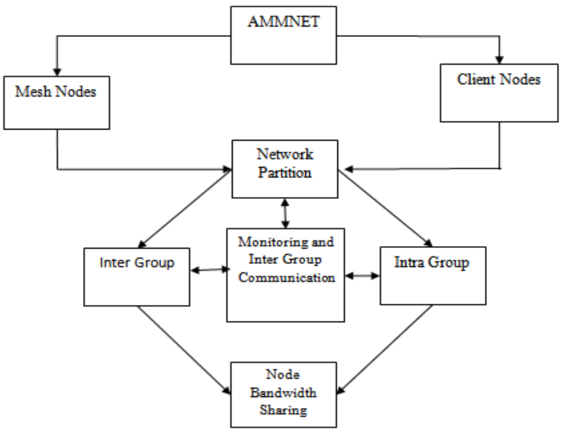


Fig. 3. System Architecture

The mobile clients stats moving and undergo network partition. The mesh node follows the mobile client and form groups of clients. The mesh nodes act as inter-router and intra-router to make all mobile clients to communicate with them. After formation of groups the bandwidth of mesh node is shared with the mobile clients dynamically, such that no mobile client in a same group is given with same bandwidth at a time.

A. Mobile Client Tracking

At first all the mobile clients send Becon message to the mesh node within its range. The mesh node check the client list to find the client from which it got message and if it is not present, request to neighboring mesh nodes for client list. If mobile client is present in inter-group then router and identify the node. If the mobile node is new then mesh node adds the node to its list and follow the new mobile client of that group.

Algorithm 1: Mobile tracking algorithm
Step1: Send Becon message interval to mesh node.
Step2: In intra-group request client list and all are covered by neighbors.
Step3: In inter-group, retrieve location of router and identify.
Step4: If free, navigate to inter-group and request router to follow the new intra-group member (mobile client)
Step5: Repeat and end

B. Topology Adoption Locally

A star topology of the local routers is created by converting intra-group router to inter-group routers, of which other group inter-group router is in its range. Then all neighbor inter-group routers are computed to star topology and bridge network is build to connect bridge network. The routers are triggered to adopt new topology and then free routers are reclaimed to add to the new topology

Algorithm 2: Connectivity of new topology locally
Step1: Compute single star topology model.
Step 2: Build bridge network connecting all neighbors.
Step 3: Trigger router to adopt new topology.
Step 4: Reclaim free router to topology.
Step 5: End

C. Topology Adoption Globally

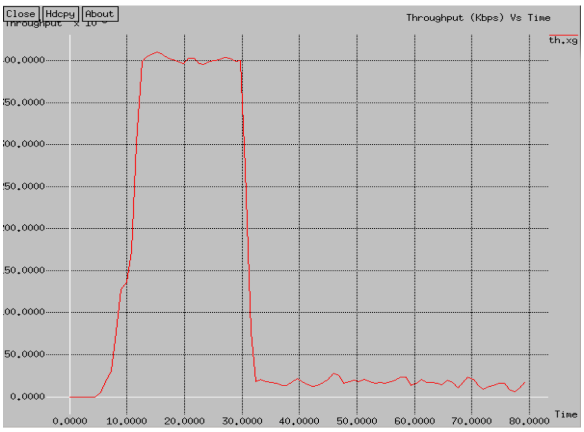
After construction of local topology, a star topology should be connected between free routers, which there are no mobile clients in its range and triggered as free routers. A message is broadcasted to all the routers to collect routers location information to adopt global topology such that all groups are inter connected by bridge network. If there are free routers present a subset is formed and free routers are deployed. Another subset of inter-group routers are connected to free routers and a global star topology is constructed.

Algorithm 3: Connectivity of new topology globally
Step1: Broadcast a message to all bridge routers to collect information and coordinate global adoption.
Step 2: If free router, deploy a subset of inter-group router.
Step 3: Free routers deploy a subnet of router.
Step 4: If router at inter-group are more, adopt free subnet of router to connect to inter-group routers.
Step 5: Send Becon messages to router and collect information and repeat.

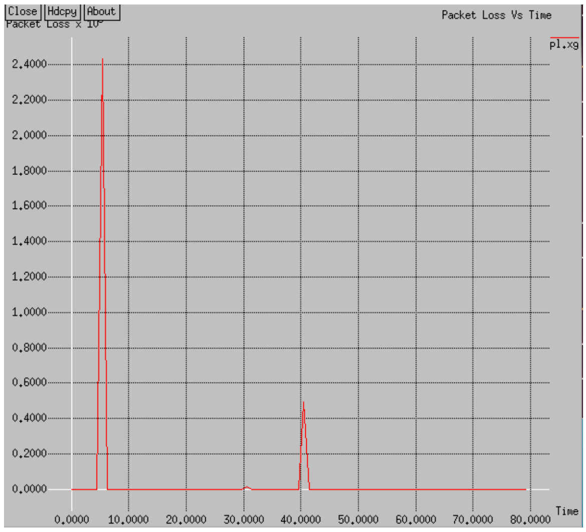
D. Spectrum Sharing

Dynamic Spectrum Access Protocol is used to share the bandwidth with the mobile clients. Using this protocol the mobile clients in same group share the bandwidth range of mesh node dynamically. This also helps client to client communication in intra-group. This protocol is opportunistic as a link between two clients can only be utilized with their use of the spectrum stays within the interference temperature of the network

VI. RESULT



To find throughput of the data forwarding of the mobile clients in the network a xgraph is plotted by taking throughput in Kbps versus time. When the mobile clients transmit data in a group without moving to another groups the through put is maximum, but if mobile clients changes group the throughput will reduce by small amount.



The loss of packets is found by plotting a graph of packet loss at y axis and time at x axis. At the time of topology adaption and reconstruction the mesh nodes are over headed and packet loss will be more. At the time of no over head there is a minimum or no packet loss is occurred.

VII. CONCLUSION

A set of mobile nodes will communicate in application terrine without undergoing network portioning with the help of mesh nodes by forming inter-groups and intra-groups. The adoption of network topology with introduction of new nodes is dynamically done in AMMNET. The overlapping of channels in mobile clients is minimized by dynamic spectrum sharing protocol. But problems like finding of missing client by mesh node still difficult to implement. Increasing mobile client will increase the overhead in mesh client.

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