Mobile Ad-HOcMEsh Network (MAHOMEN) in Remote Areas: An Innovative Case Study

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Abstract: The paper highlights the application of Hotspot [4] concept using Dijkstra's Algorithm in remote areas where traditional mobile infrastructure doesn't exist. We propose a Hotspot [5] based Ad-hoc Mesh Network called **MAHOMEN** to establish connectivity using a smartphone with Hotspot facility. The **MAHOMEN** provides a unique, innovative and self-organized infrastructure to communicate within a community residing in the remote areas. Our technology applies the Dijkstra's algorithm (which selects the shortest path in the mesh) in the **MAHOMEN** for two or more devices to communicate without traditional & conventional cellular network.

Keywords—Ad-Hoc Mesh Net, Dijkstra's Algorithm, Remote Area, Hotspot

I. INTRODUCTION

Today, Earth is surrounded by Hi-speed networks but that doesn't cover the entire globe leaving a big portion of the world still unconnected not only to the rest of world but with themselves nearby. Without cellular or landline voice or data communications, citizens in the most hard-hit locations don't have the ability to contact others. Currently, there exists no mobile system which establishes communication without the use of Cellular and Voice data communications. The novel and unique self-organized network- MAHOMEN enables the phone to communication with each other without the traditional telecommunication base station.

The MAHOMEN creates a wireless Ad-Hoc[3] network between the various smartphones and enables them to communicate with each other without the requirement of telecommunication base station. It assists citizens to connect to others. Using the mobile application individuals can locate their loved ones and communicate. MAHOMEN is the Ad-Hoc wireless network created which is used in the process of transferring the messages from one smartphone to another. This forms the core technology used to get people connected with family friends and others without traditional cellular and data communication infrastructure.

Ad-Hoc network is an effective way to connect the devices through the network established through a mesh network connecting many nodes nearby and thus facilitating the communication. The Ad-Hoc network established is Infrastructure-less as it doesn't require any additional hardware thus making it cost effective and can be afforded by people in the remote regions who are not financially sound.

II. PEER TO PEER MESH NETWORKING

Peer to peer mesh networking service is used for making an offline network to connect between different phones. It uses the Hotspot for establishing a connection between networks and for transferring data between different phones. This basically makes use of other mobiles like stepping stones allowing it to grow to the edge of any crowd. The algorithm developed by us is derived from Dijkstra's Algorithm and makes communication more effective.

The basic principle lies in this concept is that communication between two nodes that are sufficiently far away to be in the range of their local Hotspot can be facilitated by an intermediate node acting as a postman between them transferring data received from one node to another. The third party acting as a Postman cannot alter or read the contents of the data due to end to end encryption of data, thus ensuring both privacy and Integrity of the data making it more Secure. We are using **Tox** protocol to implement the end to end encryption. Tox [6] is a peer-to-peer instant messaging and video calling protocol that offers end-to-end encryption.The stated goal of the project is to provide secure yet easily accessible communication for everyone. To increase the range of the network communication we use more than one intermediate nodes

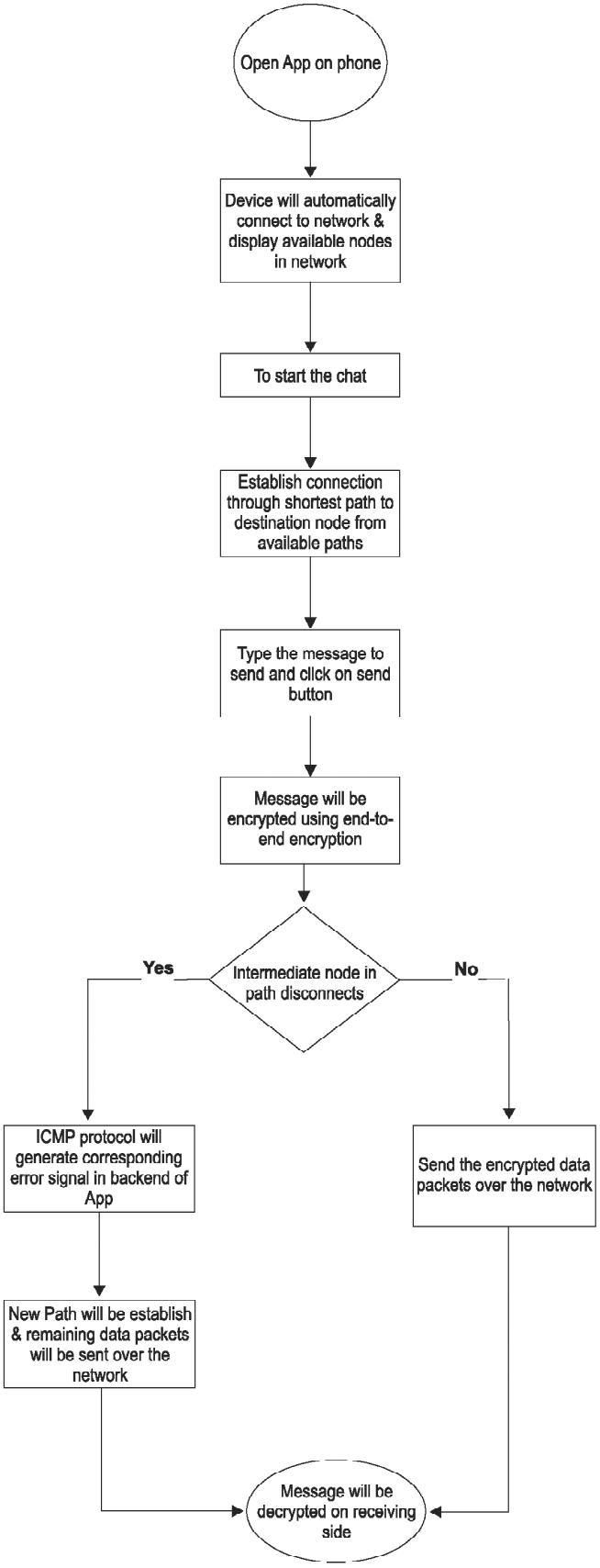


Fig. 1 MAHOMEN Flow-Chart

as required and the selection of intermediate nodes from the mesh who will be participating in a particular session of exchange of data is selected by Dijkstra's Algorithm.

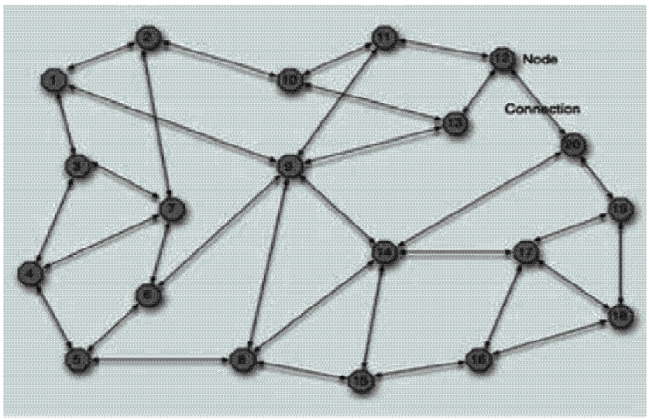


Fig. 2. Interconnection of Nodes

The user "A" has a smartphone (node) that has all features a common smartphone has but he is unable to communicate to "B" who also have a smartphone (node) because they are out of the reach of the cellular network. They both want to send messages to each other so they decided to connect through Wi-Fi hotspot to do so, but again they can't do so as they are not within the range limits of Wi-Fi Hotspot. Now this kind of communication can be established by using an intermediate third node "C" which is in the range of both "A" and "B". This was just a simple case of communication of two nodes supported by a third node. This simple network of 3 nodes can be extended to many devices from a few to hundreds connecting nodes of an entire village, Town or a City.

During the transmission, it is possible that any intermediate node disconnects abruptly. To solve this problem, we are implementing ICMP[7] protocol so that during communication if any intermediate node disconnects from the network then with the help of ICMP protocol we will generate a signal indicating the problem in the path and the remaining packets of data will be sent again after calculation a new path for communication.

III. METHODOLOGY

The methodology which works behind the Dijkstra Algorithm is based on finding the closest distance to the node in a network. It provides us the best shortest distance among all the nodes. It works by first checking the condition that the distance between the parent node

and child nodes, the one which comes shortest we move to that side because as we know the motive of our algorithm is to get the shortest path among others nodes so that transmission of data could be fast enough.

We maintain two sets, one set contains vertices included in shortest path tree, other set includes vertices not yet included in shortest path tree. At every step of the algorithm, we find a vertex which is in the other set (set of not yet included) and has a minimum distance from the source.

Below are the detailed steps used in Dijkstra's algorithm to find the shortest path from a single source vertex to all other vertices in the given graph.

Algorithm

1) Create a set sptSet (shortest path tree set) that keeps track of vertices included in shortest path tree, i.e., whose minimum distance from the source is calculated and finalized. Initially, this set is empty.

2) Assign a distance value to all vertices in the input graph. Initialize all distance values as INFINITE. Assign distance value as 0 for the source vertex so that it is picked first.

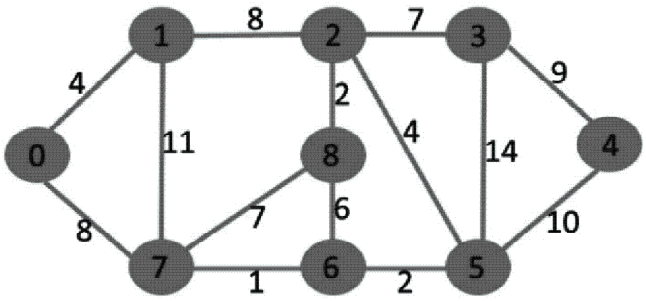
3) While sptSet doesn't include all vertices

a) Pick a vertex u which is not there in sptSetand has minimum distance value.

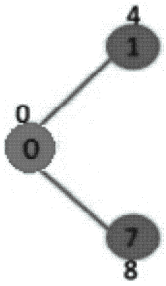
b) Include u to sptSet.

c) Update distance value of all adjacent vertices of u. To update the distance values, iterate through all adjacent vertices. For every adjacent vertex v, if the sum of distance value of u (from source) and weight of edge u-v, is less than the distance value of v, then update the distance value of v.

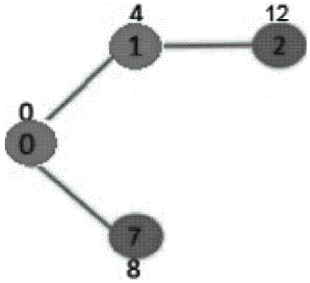
Let us understand with the following example:



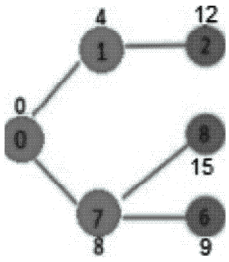
The set *sptSet*is initially empty and distances assigned to vertices are {0, INF, INF, INF, INF, INF, INF, INF} where INF indicates infinite. Now pick the vertex with minimum distance value. The vertex 0 is picked, include it in *sptSet*. So *sptSet* becomes {0}. After including 0 to *sptSet*, update distance values of its adjacent vertices. Adjacent vertices of 0 are 1 and 7. The distance values of 1 and 7 are updated as 4 and 8. Following subgraph shows vertices and their distance values, only the vertices with finite distance values are shown. The vertices included in SPT are shown in green color.



Pick the vertex with minimum distance value and not already included in SPT (not in sptSET). The vertex 1 is picked and added to sptSet. So sptSet now becomes {0, 1}. Update the distance values of adjacent vertices of 1. The distance value of vertex 2 becomes 12.



Pick the vertex with minimum distance value and not already included in SPT (not in sptSET). Vertex 7 is picked. So sptSet now becomes {0, 1, 7}. Update the distance values of adjacent vertices of 7. The distance value of vertex 6 and 8 becomes finite (15 and 9 respectively).



Pick the vertex with minimum distance value and not already included in SPT (not in sptSET). Vertex 6 is picked. So sptSet now becomes {0, 1, 7, 6}. Update the distance values of adjacent vertices of 6. The distance value of vertex 5 and 8 are updated.

We repeat the above steps until *sptSet* doesn't include all vertices of given graph. Finally, we get the following Shortest Path Tree (SPT).

IV. CONCLUSION AND FUTURE WORK

In this paper, we have proposed Hotspot based Ad-hoc Mesh Network called **MAHOMEN**about an ad-hoc networking concept that facilitates to connect to many smartphones at a time creating a mesh network of interconnected nodes. The nodes participate in the mesh to facilitate the communication among people in remote areas where conventional & traditional cellular network connections are absent. We have studied that how these nodes participate in the communication among people in which many short-range networks are joined together to make a bigger network increasing the range of communication. The future scope of this research paper is to improve the network range and fast communication through improvements in the algorithm and thus creating an effective and reliable network.

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