ISSN No. 0976-5697

Volume 8, No. 5, May – June 2017

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

A Study On The Role Of Mobile Adhoc Networks (MANETS) In Disaster Management

Dr. Deepshikha Aggarwal
Department of Information Technology
Jagan Institute of Management Studies
Delhi, India

Abstract: A Mobile Ad Hoc Network (MANET) is defined as a collection of two or more nodes connected with each other through some kind of wireless communications and networking capability that enables them to communicate with each other without the need of any centralized server. This enables the wireless nodes to dynamically form a network to exchange information without using any existing fixed network infrastructure. It is an autonomous system in which mobile hosts connected by wireless links are free to be dynamically behaving as either the nodes or act as routers at the same time. The main advantages of MANET are robustness, flexibility and mobility. In this paper, we explore these advantages of MANET for disaster management. Whenever a disaster occurs, the major problem that hampers the relief operation is lack of communication as most of the times the communication networks in the disaster affected areas are damaged partially or fully. The MANET being a kind of on demand network, comes as a rescue for the damaged networks and can be of tremendous use in disaster management.

Keywords: Wireless Networks, MANET, Disaster Management, Ad Hoc Networks.

I. INTRODUCTION

An Adhoc network is a set of independent nodes connected together with a wireless link [1]. The nodes in the ad hoc network communicate with other nodes without any physical connection or fixed topology. The nodes can instantly form the network whenever the need for communication is established and communicate using radio waves. It is a distributed network and the nodes communicate with each other without fixed station access point (AP) or base station. [2]. Due to the absence of a centralized server, the nodes in an ad hoc network also act as routers to send and receive the data . The main advantage of adhoc networks is that due to their non-static nature, the single point of failure is avoided which makes them more robust and ideal for adverse conditions such as disaster management. Various man-made and natural disasters have highlighted the need for effective communication systems that would help in disaster management in warning and rescue operations. Whenever a disaster situation occurs, problems in the process of disaster management come up due to the lack of communication facilities. Due to the damage of communication network, it becomes impossible to send disaster warnings to nearby areas and to transmit updates about the exact situation of losses after disaster monitoring that could aid in rescue operations. During disasters, the Local Area Networks (LANs) are also affected and they cannot be used for communication either. The overall scenario in a disaster struck area is hostile and in order to operate in such environments the networks deployed should be robust and irrepressible. An emergency on demand network has to be set up that has to provide the required Quality of Service (QoS) to ensure augmented performance with limited resources. Moreover all this has to be done in a limited time span as lives are at stake. Whenever a disaster strikes, communication links are often disrupted partially or fully, but for the disaster relief teams, these links are very essential in order to effectively provide disaster recovery and for this they have to find information about critical questions such as which are the affected areas exactly, how many people have been injured or died, where the injured are exactly located and the amount of manpower and medical help needed[3]. In disaster and emergency situations, communications can save lives. In earlier times, when the communication systems were not much developed, the relief operations in disaster like emergency situations was not very effective. Even today, in under developed nations, where the communication infrastructure is weak, the emergency management is poor. The lack of funds for communication development leads to weaker infrastructures as compared to the developed nations where lot of focus is given to the development of communication facilities. The breakdown of communications infrastructure, due to the collapse of antennas and buildings and disruption of power supply in the affected areas is the usual effect of disaster. Whether partial or complete, the failure of communication infrastructure leads to delays in rescue operations in disaster affected areas and ultimately causes loss of lives and damage to property which could have been prevented [4]. Despite the increasing trustworthiness of modern communication networks, the risks associated with communication failures are a cause of serious concern because of the growing dependence on these systems for emergency situation management. Wireless adhoc networks are therefore finding way into all sorts of emergency management situations.

II. WIRELESS AD HOC NETWORKS

A wireless adhoc network also referred to as a mobile adhoc network (MANET) is a collection of two or more devices or nodes which are connected to each other through wireless communication media. The networking capability of these networks is established with or without the need of any centralized server or access point. These nodes can dynamically form a network to exchange information without using any existing fixed network infrastructure. It is an autonomous system in which mobile hosts are connected by wireless links and these nodes are free to act as nodes themselves or as routers at the same time as per the communication requirements of the network. All nodes in a wireless ad hoc network may have to act as a router and host at the same time as the network topology in an adhoc network is also dynamic and may change with nodes joining and leaving the network. These special

features of Mobile Ad Hoc Network (MANET) makes this technology of great use but is accompanied by several challenges [8].

All the nodes and devices are responsible to organize themselves dynamically for the communication between each other and to provide the required network functionality in the absence of fixed infrastructure. Thus, in such kind of networks, the maintenance, routing and management are performed by all the nodes.

III. WIRELESS NETWORKS

Wireless networks offer connection flexibility as users can dynamically join or leave the network and they also help in the extension of the network without a physical-wired connection. Wireless networks are of two types; Infrastructure networks and Ad-Hoc networks [9].

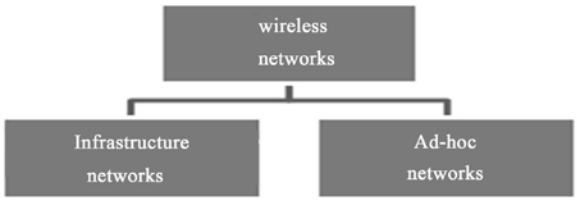

Figure 1: Types of wireless networks

A. *Wireless Network Infrastructure Mode*

In a wireless LAN (WLAN) there are two system entities: Access Point(AP) and Stations(STAs).

Access Point (AP) denotes a central controller for each device. The network can be joined through access point by any node. All the communications between stations will go through AP. Access point is like a router.

Stations are the nodes on the network that contain the network interface card (NIC) for connecting to the wireless network. Both of the devices are compliant with IEEE 802.11 family of protocols. There are series of standards released under IEEE 802.11.

In infrastructure mode of the wireless network all the stations including wireless devices and all other nodes communicate through the Access Point(AP). The AP provides connectivity between wireless network and the wired LAN network. Since the access point is connecting both wired and wireless network, it has the capability to carry the data packets from protocol IEEE 802.11 to IEEE 802.3 and vice versa.

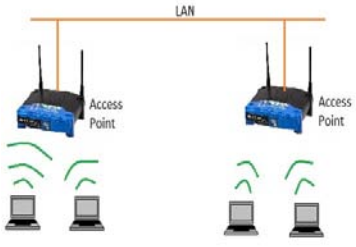

Figure 2: Wireless Network Infrastructure mode

B. *Wireless Network Adhoc Mode*

Infrastructure less or AdHoc networks do not have a fixed topology or a central controlling point and consist of only stations which are 802.11 compliant. There is no access point (AP) in the network and the stations communicate directly with one another through radio waves. Adhoc mode is suitable for quick network setup in in places where wired infrastructure is not available. The self-supporting nature of ad hoc networks makes them quite useful in situations such as natural disasters, emergency military operations, or even to just quickly transfer information between two computers at home or office[9].

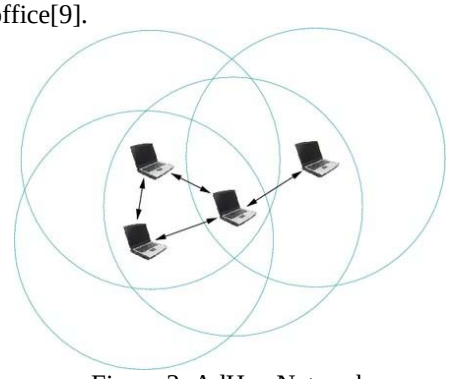

Figure 3: AdHoc Network

IV. MOBILE AD HOC NETWORKS (MANET)

A Mobile Ad hoc Network (MANET) is an independent network of mobile devices that are connected over various wireless links. It works on a limited bandwidth. The network topologies are dynamic and may vary from time to time. Each node on a MANET may act as a router for transferring data among the connected devices. This network has the capability to operate by itself or it may be connected to a fixed network through an access point. The application of MANET can ranged from small, static networks that are limited by bandwidth and power, to large-scale, mobile, highly dynamic networks[10].

Since a MANET does not require a fixed infrastructure, it is a highly suitable network in circumstances where fixed infrastructure is not available or is damaged due to a disaster and setting up of new infrastructure is not possible as it will be costly and time consuming.

The nodes on a MANET work as routers also and separate installation of routers is not required. This leads to quickly installation of the network with minimum user intervention. There is no central access point for the network and the topology is not fixed. Therefore, all the devices are free to move and can join and leave the network as per the requirement. MANETs can be connected to the Internet as different types of devices can be used in this network that can be made compatible with existing cellular network infrastructures to extend the coverage and interconnectivity.

V. ROUTING PROTOCOLS FOR MANETS

Routing in MANETs consists of Route discovery and route maintenance.

Route discovery is the process of Initial discovery of valid route from source to destination. For this, the Source node can send a query for a destination node. Only destination node responds to query and if the destination is located in source's transmission range, destination responds and the link is established. No periodic routing updates are needed in MANET.

Route Maintenance process of maintaining the route once established. Nodes can determine broken links through ACK/NACK included with most protocols. If a link is broken, the node that detects the broken link either reports this information back to the sending node or the node can try to fix

the broken link by sending out its own route request to the destination. If no ACK/NACK is present in the link-layer protocol, nodes can listen to channel to determine if next hop transmits packet or not. If the node does not hear forwarding of packet, it assumes that the link is lost. Explicit routing acknowledgements can also be used to determine the state of the links.

The routing protocols in MANET are classified as Proactive Routing Protocols and Reactive Routing Protocols.

A. Proactive Routing Protocols

Proactive routing are those protocols that require the nodes to continuously evaluate and update the routes. Each node maintains consistent, up-to-date routing information in the form of a table with the next-hop to reach every node in the network. Changes in link state are transmitted throughout the network to update each node's routing table.

Proactive routing protocols

- DSDV
- CGSR

B. Reactive Routing Protocols

Reactive Routing Protocols are those routing protocols where the nodes evaluate and update routes only when they are needed. When a node has a packet to send, it checks to see if it has a valid route to the destination. If there is no valid route known, node must send out a route-request message to obtain a valid route (controlled flooding of the network). Data is sent to the destination using the valid route. This type of routing is efficient if the routes are not used often. Routes are created only when needed. This requires "route discovery" and "route maintenance". This is also called "source-initiated on-demand routing" and the goal is to minimize the amount of overhead compared with proactive routing at the expense of latency in finding a route when it is needed.

Reactive routing protocols

- AODV
- DSR

C. Comparison of Protocols

Proactive approaches

- More efficient when the routes are used often
- Assures that the routes are ready when needed
- Requires periodic route updates and hence cause the overhead
- Node mobility affects the entire network as routing Updates are required

Reactive approaches

- More efficient when routes are used occasionally
- Require node to first find a route before the data can be transmitted
- Periodic route updates not required
- Can have localized route discovery to deal with node mobility

VI. DISASTER MANAGEMENT

A disaster is an unforeseen event or an accident caused by human intervention or due to natural calamities that causes loss of lives and infrastructure in the affected areas. Although it occurs rarely but it cannot be avoided whenever it's bound to occur leading to catastrophic loss of property, money and lives resulting in tremendous damages to human civilization, ecosystem and the overall environment. Disaster management is the process of monitoring, controlling, planning and responding to the disaster situation and includes both pre and post disaster activities. It refers to the management of both the risk and the consequences of disaster. [5]

Disaster monitoring and management is one of the most challenging and important application of wireless ad hoc networks. It is so because whenever a disaster occurs, it destroys the communication networks and one of the initial steps in disaster management is to set up communication with the affected areas. As establishing infrastructure based networks are neither feasible nor suitable in these environments, wireless adhoc networks seem to be an effective means to establish communication. The disaster being an unforeseen event, strikes suddenly and does not give time to the authorities for advance planning to anticipate and manage the situation to minimize its effect.

VII. MANET BASED DISASTER MANAGEMENT

One of the major effects of catastrophic disasters is the failure of conventional communication systems. The communication towers are generally collapsed completely or partially after the disaster strikes. This further makes the rescue operations difficult as the authorities are not getting proper updates of the actual loss and the help required [6]. In order to deploy the disaster relief operations to save human lives, communication networks are extremely important. Communication and exchange of Information are extremely vital for disaster response in order to gather information and make important decisions. Therefore, one of the first things required to start the rescue operations after the disaster strikes is a rapidly deployable, robust to failures, easily maintainable and service provider independent communication system. The available technology options for this purpose are limited and one of the most helpful technologies for the purpose is of wireless adhoc networks [11]. Use of wireless Ad-hoc networks to set up a communication network by utilizing only the existing infrastructure in a post disaster situation can help in coordinating the activities for disaster management. The wireless adhoc network can be set up by using the existing laptops and smartphones also which may have not been destroyed by the disaster. These devices can communicate among themselves by forming a Mobile AdHoc Network (MANET).[12,13] To communicate with the control system that is situated far away, only one of the devices in the MANET has to be connected to a long distance transceiver. Such kind of a network can be used for disaster management by enabling the disaster struck people to share the updates of the situation with the disaster monitoring team and as per the situation, the rescue operations can be planned and executed.

VIII. CONCLUSION

Disaster is a condition that is unavoidable most of the times. Disaster management deals with handling the disaster in the best possible manner and it involves disaster monitoring and disaster relief. Ensuring strong communication during disaster relief is very important for rescue operations, as it helps in locating the affected areas and people and therefore allows the relief team to reach out to them and provide help. Tragedies caused by man-made and natural disasters have highlighted serious flaws in the communication systems especially in under developed countries and the need for more effective disaster monitoring and response systems has been felt. Wireless networks are currently undergoing extensive research

to create better wireless systems for emergency situations. A lot of progress has been made in wireless technology for disaster relief and the ongoing research in this area is very promising.

One of the most useful developments in the field of communication technology is wireless adhoc networks. These networks being able to function without the fixed infrastructure are very useful in situations when the communication infrastructure is damaged due to a disaster. Mobile Ad hoc Network (MANET) can be used in emergency situations for rescue operations for disaster relief where communication infrastructure is either nonexistent or damaged and an infrastructure less on demand communication network is required. This kind of a network can be set up by using small handheld devices such as smartphones or tablets and information sharing can be done from one rescue team member to another. Most of the times, disasters strike without any prior warning and establishment of infrastructure for communication is therefore not possible especially in remote areas where there are no preexisting communication systems. In this situation also, MANET is the best the solution for communication for disaster management.

IX. REFERENCES

[1] Corson, M.S., Batsell, S. and Macker, J. 1996. Architecture consideration for mobile mesh networking. Proc. of the IEEE Military Commun. Conf. (MILCOM). 1: 225-229.

[2] Frodigh, M., Jhansson, P. and Larsson, P. 2000. Wireless ad hoc networking: The art of networking without a network. Ericsson Rev. 4: 248-263.

[3] .Stojmenovic, I. and Lin, X. 2000. Power-aware localized routing in wireless networks. Proc. of IEEE Int. Parallel and Distributed Processing Symp., Cancum, Mexico. pp.371-376

[4] Odeh, A., Abdel Fattah, E. and Alshowkan, M. (2012) Performance Evaluation of AODV and DSR Routing Protocolsin MANET Networks.

[5] Balaji. D, Sankar. R, Karthi. S, “GIS approach for disaster management through awareness - an overview” Map India 2002.

[6] Darrell M West; Elizabeth Valentini, "How Mobile Devices are Transforming Disaster Relief and Public Safety", Center for Technology Innovation at Brookings (Issues in Technology Innovation), White Paper, 16th July 2013,Washington, DC. http://www.insidepolitics.org/brookingsreports/Disaster%20Relief.pdf

[7] http://www.comp.brad.ac.uk/~sburuha1/ wirelessadhoc.htm

[8] In conclusion, health, free wireless network multi-path redundant mechanisms, in June 2008.

[9] IEEE Computer Society LAN MAN Standards Committee, Wireless LAN medium access control (MAC) and physical layer (PHY) specifications, IEEE standard 802.11, 1997. The Institute of Electrical and Electronics Engineers, New York, NY, 1997.

[10] IEEE Computer Society. IEEE standard for information technology telecommunications andinformation exchange between systems – local and metropolitan networks – specific requirements – part

[11] Wireless LAN medium access control (MAC) and physical layer (PHY) specifications: Higher speed physical layer (PHY) extension in the 2.4 GHz band, 1999.

[11] M. Frodigh, P. Johansson, and P. Larsson.“Wireless ad hoc networking: the art of networking without a network,” Ericsson Review, No.4, 2000, pp. 248-263.

[12] D. Estrin et al, “New Century Challenges: Scalable Coordination in Sensor Networks”, ACM Mobicom, 1999.

[13]http://www.computingunplugged.com/issues/issue200410/00001398001.html

[14] http://www.tech-faq.com/ad-hoc-network.html