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Research Paper

An Approach to Opted Path Restore Technique for Routing Protocol in Ad-Hoc Network

Deepesh Namdev[1], Rajeshwaree Parashar[2]
[1]*HOD cum Associate Processor [EC&EE], Gurukul Institute of Engg. &Technology, Kota (Raj.), India*
[2]*Student of Gurukul Institute of Engg. & Technology, Kota (Raj.), India*

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ABSTRACT :- In MANET communication between mobile nodes is possible, when they are in range of each other. The mobile nodes are variable in nature and the network topology may be configured in an arbitrary manner and change dynamically. Thus the variable topology and node mobility may cause the link failure problem. MANETs are being used in many application scenarios such as: military and battlefield, search and rescue operation, disaster recovery, public safety and personal area network etc. MANETs have dynamic environment and variable nature, which causes the link failure problem i.e. due to node mobility, loss of energy, node failure etc. To overcome the broken link problem, initiated route repair mechanism. The mechanism is proposed for selection of route repair techniques. In this approach, the different route repair values are defined on the basis of the active path of a network and how to calculate the link break value for finding in which location the link break is occurring to initiate route repair mechanism.

KEYWORDS:- MANETs, Challenges, Routing Protocol.

I. INTRODUCTION

The wireless network is a group of wireless devices connected by radio waves such as laptops, PDA etc. In which each device is capable of forwarding data packets to each other and communicates over the wide range of networks.

- Infrastructure wireless network
- Infrastructure less wireless network (Ad-hoc Network)

Infrastructure Network: The infrastructure networks have a fixed base station or access point, which represents central coordinator for all devices. In which all devices connected to other devices or base stations through wires and each node exists within the range of a base station. Infrastructure wireless networks as shown in Figure 1.1

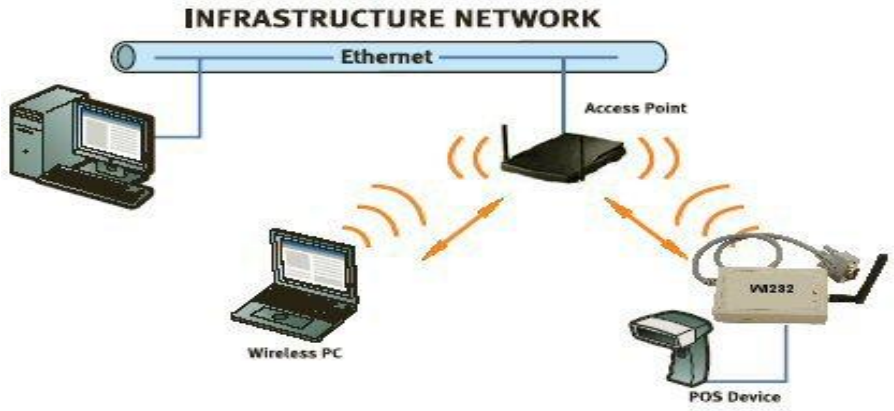

Fig. 1: Infrastructure Wireless Networks

One drawback of using an infrastructure network is large overhead. For example: this type of network includes wireless local area network [2].

Infrastructure less Network: The mobile ad-hoc network (MANET) is an infrastructure less wireless ad-hoc network. It is self-organized and autonomous network of mobile nodes connected by wireless links and does not depend on any centralized access point or base station. Each node in the network may act as a router or as a host and are free to move independently. In MANET communication between mobile nodes is possible, when they are in range of each other. The mobile nodes are variable in nature and the network topology may be configured in an arbitrary manner and change dynamically. Thus the variable topology and node mobility may cause the link failure problem [1] [2].

For example: Bluetooth and IEEE 802.11 standard are the two most popular technologies being used today for wireless interface with ad-hoc network. The Bluetooth device is ideal for small devices and short range low power radio links.

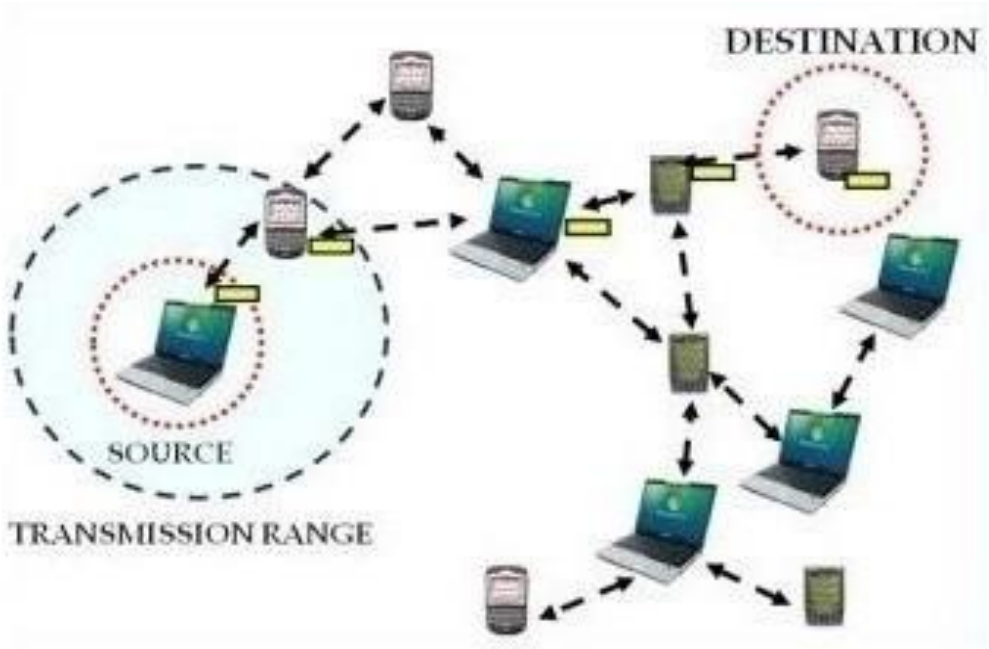

Fig.2: Mobile Ad-hoc Network

The mobile devices in the network may rely on power resources such as battery life. It is very essential that an ad-hoc network running any application during transmission. This transmission power affects the battery life and a range of mobile hosts [2].

1.1 Characteristics of MANET

The mobile nature and lack of fixed infrastructure, MANET has added a number of characteristics as defined below:

Infrastructure less: MANET is self-organized and autonomous collection of mobile nodes. In which each mobile device is connected by wireless links and does not depend on any pre- established infrastructure or central access point.

Autonomous Terminal: In MANET each mobile device is an autonomous and may independently perform the function of a router or a host for communication [3].

Multi-hop Routing: In MANET ad-hoc routing algorithms are single-hop and multi-hop based on different routing protocols and link layer attributes.

Dynamic Network Topologies: All mobile nodes in MANET are free to move arbitrarily in any direction and frequently change its topology to other nodes in the network.

Energy Constrained Operation: Each mobile devices have limited power supply because it carries battery power [3].

1.2 Applications of MANET

In day-to-day application such as email and file transfer can be considered within an ad hoc network environment. Some application of Ad-hoc networks are defined as follows:

Military Battlefield: Ad-hoc networks are used in military communication and battlefields operation to maintain the information between soldiers, vehicles and military headquarters.
Emergency services: Ad-hoc network can be used in emergency and rescue operation for disaster recovery i.e. firefighting, flood, and earthquake. The emergency rescue operation must take place where non existing or damaged communication infrastructure and rapid development of communication network is needed [4].
Civilian and commercial environment: Ad-hoc network can directly exchange the information between local area network such as eCommerce, dynamic database access and mobile office. Other civilian services of ad-hoc networks are included the vehicular services, sports medium, shopping mall and small aircraft.
Personal area network: Interconnection between short ranges of mobile devices like laptop, office wireless network, conference rooms, home networks etc.
Education: Ad-hoc communication during lectures, virtual classrooms and campus network setting.
Coverage extension: Linking up with the internet or intranet.
Entertainment: Multi user games [3] [4].

1.3 Challenges of MANET

The key challenges faced at different layers of MANET [5] are shown in figure 1.3. It shows the layered architecture of ad - hoc networks.

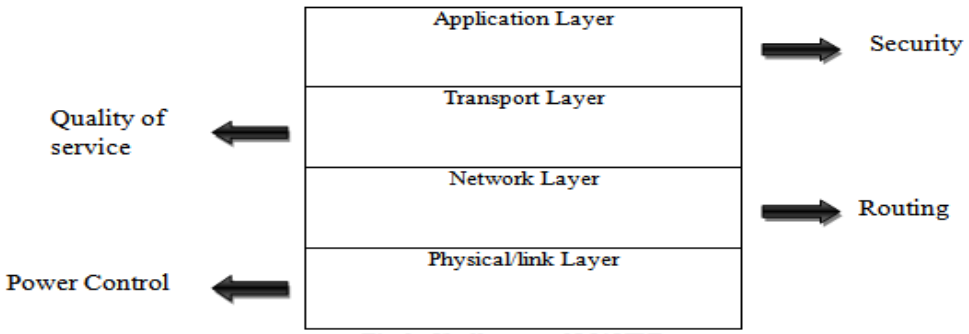

Fig.3: Challenges of MANET

Some of the challenges of MANET as described below:
Routing: Since the mobile nodes of MANET are free to move randomly in any direction, so the topology of the network is constantly changing and the communication between any pair of nodes is challenging task. Most of the routing protocols have been developed to recover the path.
Limited wireless transmission range: Wireless networks have limited radio bandwidth and it can offer data rates much less than as compared to wired networks. The limited transmission range also affects the routing protocols to maintain the topological information.
Packet losses due to transmission errors: Ad-hoc wireless network suffers a packet loss problem due t**o** many reasons such as high bit error rate in a wireless channel, hidden terminal problem, presence of interference problem, location dependent, unidirectional link, path break etc [6].
Security and Reliability: Due to the feature of distributed operation, ad-hoc network requires the security of connection between mobile nodes in the network. It is easy for malicious hosts to eavesdrop during communication session and this could lead to unauthorized access, information theft, interference, jamming and service degradation. Wireless links also have a reliability problem because of the limited wireless transmission range, the broadcast nature of wireless medium e.g. hidden terminal problem, mobility causes packet loss and data transmission errors.
Quality of Service: Providing quality of service in constantly changing environment will be difficult task. MANET has dynamic environment and does not provide the guarantee of services during transmission.
Energy Constrained: All of the nodes in MANET may rely on batteries then the most important criteria of system design are based on energy conversation.
Limited Bandwidth: Wireless links may have significantly lower capacity than the wired network. Also due to the multiple access, fading, noise and interference condition its the wireless links have lower throughput [6].

1.4 Routing in MANET

Routing in MANET depends on many factors such as topology, selection of routers, initiate route request and specific underlying characteristic that finding the path quickly and efficiently. Design a routing protocol is one of the major challenging issues in wireless network due to its variable nature. A routing protocol is needed when the source node wants to send data packets to destination [7].

Classification of routing protocols in MANETs is based on many ways, but most of the routing protocols are classified into two types: proactive and reactive routing protocol.

II. LITERATURE SURVEY

Numbers of the researchers have done the study in the field of route repair techniques for routing protocols. Then the related research paper of route repair techniques and the work are as described below:

2.1 Jyoti Jain, Roopam Gupta and T. K. Bandhopadhyay, "On Demand Local Link Repair Algorithm for AODV Protocol," proceeding of International Journal of Computer Applications (0975-8887) Volume 35, No. 5, December 2011, pp. 20-25.

In this paper author defines the survey of research on local repair of link and proposed the new local repair method. In proposing a local repair method, an author used Ant algorithm for finding a new route to destination, when another path of the link has already existed. A routing table is maintained with nodes, where the nodes are used to keep the address of next two-hop node in the routing table. The proposed algorithm is adaptive, scalable and efficient and reduces the end-to-end delay in mobility [8].

The link break is occurring in an active path and then the node that detects the link break locally tries to repair the route. This node broadcasts the Forward Ant (F-Ant) to other nodes for searching active path to the destination. After one or two hops the F-Ant found the required nodes that have an active route to the destination. The next new node generates Backward Ant (B-Ant) and forward back to the repairing node within the allotted time. The new route is available and this route is used for transmission. If the repairing node does not receive the B-Ant within the time, it generates the REER message back to the source node.

2.2 Saaidal R. Azzuhri, Marius Portmann and Wee Lun Tan, "Evaluation of Parameterized Route Repair in AODV," proceeding of IEEE 2010.

In this paper author defines the route repair technique for Ad-hoc On Demand Distance Vector (AODV) routing protocol. Routes can be repaired by re-establishing a new route starting from the source node, or routes can be locally repaired by the node that detects the link break along the path. In some scenario Source Repair will provide better results and in other scenario Local Repair will be the more appropriate choice for link repair [9].

In this paper author explore a flexible, parameterized approach for deciding which of these two route repair strategies are used in the case of a link break area. Author defines a Local Repair Threshold parameter that determines how far along the communication path, link break has occurred.

Route Repair Strategies: Author proposed a fixed and absolute range of threshold parameter for the selection of which route repair strategy is to choose.

Define the link break location parameter Llb as follows:

Llb= hop index of the broken link / total number of hops in the path.

For examples: suppose 5 hop paths exist between source node to the destination node and the link break has happened by node 2.

In this scenario link break calculation is as follows:

Llb = 2/5= 0.4

Where: 2 defines the hop index of broken node

5 as total number of paths from source to destination

According to the approach, in this paper threshold (T_{lr}) value is 0.5 means that the link break has happened is more than half of the path so local repair is invoked, otherwise source repair will perform. Above example shows link break location is 0.4 and Threshold is 0.5, according the approach L_{lb} is less than T_{lr} ($L_{lb} < T_{lr}$) so perform source repair.

III. PROBLEM DEFINITION AND SOLUTION

3.1 Problem Definition

MANET is a self-organized and infrastructures less network of mobile nodes connected by wireless links and allowing each device are free to move independently in any directions. MANET is constantly changing topologies therefore the communication between mobile nodes is possible when they are existing in range of each other. Once the path is established between sources to destination communication is started but it is not possible to continue to send or receive data packets due to topological changes of the MANET.

MANET is a self-creating dynamic environment of mobile nodes and suffers link failure problem due to many reasons such as:

- Node mobility
- Battery power off
- Node failure

Thus the problem definition is how to select to which route repair technique is used to repair the broken link in this situation? This research work and implementation are based on node mobility, when the node is moved out of network topology.
In mobile ad-hoc networks, the node mobility is occurred by two reasons as described below:

- Node Move: In MANET every node acts as a router and are free to leave the network any time.
- Node Add: MANETs is established in a spontaneous manner and start route discovery process for establishing the route. When a new node has entered into a network then the source node nd intermediate node send route request message to this node for establishing the new route.

3.2 Proposed Solution

The mechanism is proposed for the selection of route repair techniques. According to this approach, how to calculate the link break value of the network to find the location of broken links to initiate the route repair mechanism.
The Link break value is defined as the ratio of:
$L_{bv} = H_i$ / Total Sum ($H_s - H_d$)
Where: L_{bv} = Link break value
H_i = hops index value of the broken link

$H_s - H_d$= Sum of hops in the path (H_s = Hop count of the source node and H_d = Hop count of destination node)
The hop index value of the broken link is simply counting the number of hopes starting from the source node to the broken nodes and the sum of hops in the path is the total number of hops from source to destination node along the active route.
In the proposed solution, the different route repair values are also defined on the basis of the active path of network i.e.

- One fifth part of the path (1/5=0.2)
- One fourth part of the path (1/4=0.25)
- One third part of the path (1/3=0.33)
- Half of the path (1/2=0.5)

After the half of the path (0.5), the broken link is always repaired by the local repair approach because half of the path is already covered by the node and if the source repair approach is used then it takes more time for the new route discovery process. That's why after the half of the path local repair approach is always preferred. So in this research work after half of the path the route repair value is not defined.
On the basis of this route repair values and link break value we correctly estimate, which route repair technique is used to repair the broken link.

3.3 Proposed Algorithm

The following steps are suggested for the selection route repair techniques:
1 The program starts to forward the RREQ message
a. Check path (if it exists)
if yes then start transmission
Source node forward the RREQ message to intermediate nodes for communication and wait for the reply message and the destination node respond this RREQ message by generating a RREP message back to the source node.
b. Otherwise the destination node or intermediate node generates the RERR message for source node.
c. When a node is moved out of topology then the link is broken.
2. Calculate the link break value of the network
$L_{bv} = H_i$ / Total Sum ($H_s - H_d$)
3. Check the condition
a. if ($L_{bv} > R_{RV}$)
b. If yes
The link break value of the network is more than the define route repair value. So perform the local repair approach for repairing this broken link
c. else
The link break value of the network is less than the define route repair value. So perform the source repair approach for repairing this broken link.

In reactive routing protocol route discovery is initiated in an on-demand manner by broadcasting a RREQ message to neighbor nodes and wait for RREP message. If the communication path exists then the transmission is started between sources to destination and if the path does not exist then the neighbor nodes generate the RERR message for source node. After that the link has broken then calculates the link break value

for finding in which location of network the link is broken to initiate route repair mechanism and apply the proposed approach.

According to the proposed approach, the selection of route repair techniques is described below:

- The link break value of the network is more than the route repair value means the link is broken after the defined route repair value then this link is repaired by the local repair approach.
- The link break value of the network is less than the route repair value means the link is broken before the defined route repair value then perform the source repair approach to repair the broken link.
- Performance Analysis: After the simulation the data are available as a time-stamped event trace.
- Graphical Visualization: The data collected in a simulation can be used to plot graph using the tools like Gnuplot graph or X-graph.

IV. CONCLUSION

Mobile ad-hoc network (MANET) is an infrastructure less and self organized wireless ad-hoc network. In which each mobile node is connected by wireless links and does not depend on any centralized access point or base station. MANET allows the devices are free to move independently in any direction. Thus the network topology may be configured in an arbitrary manner and change dynamically. So the MANET causes the link failure problem due to its variable nature and node mobility.

MANET does not provide the guarantee of delivering data packets before the execution because the mobile nodes frequently change its topology and leave the network then the active routes are broken from source to destination. That's why the routing is one of the major challenging issues in mobile ad-hoc network due to its variable nature.

In this research work, we make a study about the route repair techniques for routing protocol in highly dynamic nature of mobile ad-hoc networks. For simulation, creates different network scenarios, where some mobile nodes change their positions due to the node mobility.

Calculate the link break value of the network, for finding in which location the broken link has occurred in the network and define the different route repair values on the basis of the active path of the network for estimating which route repair technique is used. Used different route repair value for each scenario for selection of route repair mechanism and find the optimal result of route repair techniques.

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