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Implementation of "Early Congestion Detection Technique" Using Mobile Ad-hoc Network

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ABSTRACT: Congestion in mobile ad hoc networks leads to transmission delays and packet losses and causes wastage of time and energy on recovery. In the current designs, routing is not congestion adaptive. Routing may let a congestion happen which is detected by congestion control, but dealing with congestion in this reactive manner results in longer delay and unnecessary packet loss and requires significant overhead if a new route is needed. This problem becomes more visible especially in large-scale transmission of heavy traffic such as multimedia data, where congestion is more probable and the negative impact of packet loss on the service quality is of more significance. Routing should not only be aware of, but also be adaptive to, network congestion. Routing protocols which are adaptive to the congestion status of a mobile ad hoc network can greatly improve the network performance. Many protocols which are congestion aware and congestion adaptive have been proposed. In this paper, we present a survey of congestion adaptive routing protocols for mobile ad hoc networks. Ad hoc networks consist of independent self-structured nodes. Nodes utilize a wireless medium for exchange their message or data, as a result two nodes can converse in a straight one to one connection if and only if they are within every other's transmit range.

KEYWORDS: Ad hoc networks, routing protocols, mobile computing, congestion adaptivity.

I. Introduction

A Mobile Ad-hoc Network is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas others needs the help of intermediate nodes to route their packets. Each of the node has a wireless interface to communicate with each other. These networks are fully distributed, and can work at any place without the help of any fixed infrastructure as access points or base stations. Figure 1 shows a simple ad-hoc network with 3 nodes. Node 1 and node 3 are not within range of each other, however the node 2 can be used to forward packets between node 1and node 2. The node 2 will act as a router and these three nodes together form an ad-hoc network [1].

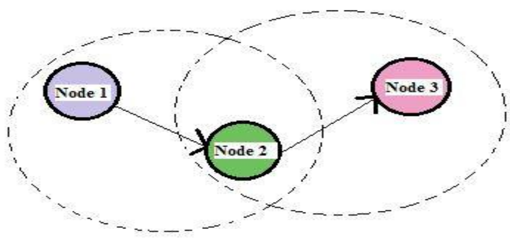

Figure1.1: Example of mobile ad-hoc network

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Mobile ad-hoc networks can turn the dream of getting connected "anywhere and at any time" into reality. Typical application examples include a disaster recovery or a military operation. Not bound to specific situations, these networks may equally show better performance in other places. As an example, we can imagine a group of peoples with laptops, in a business meeting at a place where no network services is present. They can easily network their machines by forming an ad-hoc network. This is one of the manyexamples where these networks may possibly be used.[2]

Congestion leads to transmission delay, packet loss,wastage of time and energy during congestion recovery. Routing protocol which is adaptive to mobile ad-hoc networks congestion status can greatly improve network performance. Present work proposes a congestion-adaptive routing protocol for mobile ad -hoc networks (CRP), whereas in the reported designs, routing is not congestion-adaptive. Routing allows congestion to happen which is detected by congestion control. When new route is required, dealing with congestion in this reactive manner results in longer delay, unnecessary packet loss and requires significant overhead. This problem becomes more significant especially in large-scale transmission of heavy traffic such as multimedia data, where congestion is more probable and the negative impact of packet loss on the service quality is of more significant. This work will propose a protocol called CRP which is adaptive to the network congestion [1].

It is believed that a large portion will be ad-hoc connections, which will open many opportunity MANET applications. To prepare for such promising future, routing is an important problem in need of a solution that not only works well with a small network, but also sustains efficiency and scalability as the network gets expanded and the application data gets transmitted in larger volume. Since mobile nodes have limited transmission capacity, they mostly intercommunicate by multi-hop relay. Multi-hop routing is challenged by limited wireless bandwidth, low device power, dynamically changing network topology. To overcome these problems, many routing algorithms in MANETs were proposed [3].

A homogeneous ad-hoc network suffers from poor scalability because the network performance is degraded quickly as the number of nodes increases. [6]

The following are the general causes of congestion in MANET:

1. The throughput of all nodes in a particular area gets reduced because many nodes within range of one another attempt to transmit simultaneously resulting in losses.
2. The queue or buffer used to hold packets to be transmitted may overflow within a particular node. This is also the cause of losses.

Therefore, for overcoming these issues with the help of simulation. Following are the propose methods.

1. To find the primary path from source to destination.
2. To find the shortest path from source to destination.
3. To find out the congestion which might occur on a particular node with the help of 'Early Congestion Detection Technique'.
4. To bypass the data, if congestion occurs on a node before reaching on the node having congestion or on the node on which the congestion may occur, so that time loss to reach destination will be decreased [7].

Congestion aware routing plus Rate Adaptation (CARA):

The base use of CARA protocol is DSR. The route discovery mechanism of DSR is modified. This protocol mainly aims to find the bypass route for congested zones or nodes. This can be achieved by combining the average MAC utilization and the instantaneous transmission queue length to indicate the congestion level of nodes in the network. When source wants to transmit data to the destination node, it broadcasts RREQ packets. When intermediate code receives RREQ, it checks its congestion level. If the congestion level is higher than it discards the RREQ. When RREQ arrives at the destination node, though destination node is congested or not it handles the RREQ and replies RREP. So, route without congested node is established. CARA uses two metrics to measure congestion information first is average MAC layer utilization. The instantaneous MAC layer utilization is considered as 0 only when the medium around the node is available at the beginning of a transmission and as 1 when the node is not idle. (e.g. detecting physical carrier or detecting or back off due to virtual carrier sensing.) As, the instantaneous MAC layer utilization is either 1 or 0 the average value with in the period indicates the use of wireless medium around the node. Second metric used is instantaneous transmission queue length. If the node has many packets waiting in the queue, it causes long packet latency or even dropping of packets. So we can say that node is congested now. The above mentioned metric can veraciously reflect the congestion conditions around the node. This protocol tries to minimize the congestion in two

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ways: 1) It forbids the RREQ packets to propagate in the congested area. 2) It guides the route around the congested area or nodes instead of across them. As a result of this no conditional transmission burden generate in these areas.

II. RELATED WORK

Congestion occurs in ad-hoc networks with limited resources. In such a network, packet transmission frequently suffers from collision, interference, and fading, due to shared radio and dynamic topology. Transmission errors burden the network load. Recently, there is an increasing demand on supporting multimedia communications in ad hoc networks [9].

Types of Wireless Networks

One of the unique features of wireless networks in comparison with the wired network is that data is transmitted from one point to another through wireless links i.e. there is no need of wired link between the two nodes for transmission. They just need to be in the transmission range of each other. Wireless networks or divided into two categories. Infrastructure wireless network and infrastructure less or ad hoc wireless network. [4]

I) Infrastructure Networks

Infrastructure network have fixed network topology. Wireless nodes connect through the fixed point known as base station or access point. In most cases the access point or base station is connected to the main network through wired link. The base station, or access point, is one of the important elements in such types of networks. All of the wireless connections must pass from the base station. Whenever a node is in the range of several base stations then it connect to any one of them on the bases of some criteria [10].

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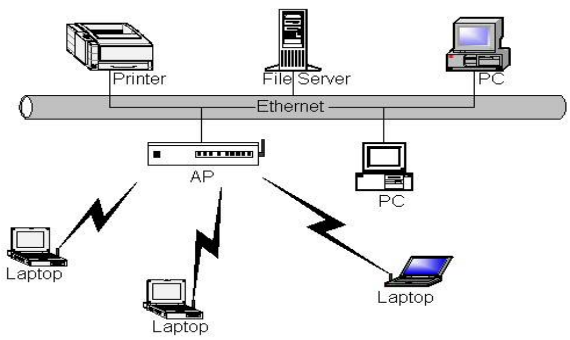

Figure2.1: Example of Infrastructure Network

II) Infrastructure-less network

Infrastructureless networks are complex distributed systems consist of wireless links between the nodes and each node also works as a router to forwards the data on behalf of other nodes. The nodes are free to join or left the network without any restriction. Thus the networks have no permanent infrastructure. In ad-hoc networks the nodes can be stationary or mobile. Therefore one can say that ad-hoc networks basically have two forms, one is static ad-hoc networks (SANET) and the otherone is called mobile ad-hoc networks (MANET). From the introduction of new technologies such as IEEE 802.11 the commercial implementation of ad-hoc network becomes possible . One of the good features of such networks is the flexibility and can be deployed very easily. Thus it is suitable for the emergency situation. But on the other side it is also very difficult to handle the operation of ad-hoc networks. Each node is responsible to handle its operation independently. Topology changes are very frequent and thus there will be need of an efficient routing protocol, whose construction is a complex task. TCP performances are also very poor in mobile ad-hoc network [1].

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III.PROPOSED ALGORITHM

The shortest path can be find on the basis of distance vector protocol. The distance vector protocol uses Bellmon-Ford algorithm. Bellmon-Ford routing algorithm is distance vector based and iterates on the number of hops a source node is from a destination node. It computes shortest paths from a single source vertex to all of the other vertices in a weighted digraph. It is slower than Dijkstra's algorithm for the same problem, but more versatile, as it is capable of handling graphs in which some of the edge weights are negative numbers. Negative edge weights are found in various applications of graphs, hence the usefulness of this algorithm. If a graph contains a "negative cycle" (i.e. a cycle whose edges sum to a negative value) that is reachable from the source, then there is no cheapest path: any path can be made cheaper by one more walk around the negative cycle. In such a case, the Bellman–Ford algorithm can detect negative cycles and report their existence. Like Dijkstra's Algorithm, Bellman–Ford is based on the principle of relaxation, in which an approximation to the correct distance is gradually replaced by more accurate values until eventually reaching the optimum solution.[9]

In both algorithms, the approximate distance to each vertex is always an overestimate of the true distance, and is replaced by the minimum of its old value with the length of a newly found path. However, Dijkstra's algorithm greedily selects the minimum-weight node that has not yet been processed, and performs this relaxation process on all of its outgoing edges; by contrast, the Bellman–Ford algorithm simply relaxes all the edges, and does this $|V| - 1$ times, where $|V|$ is the number of vertices in the graph. In each of these repetitions, the number of vertices with correctly calculated distances grows, from which it follows that eventually all vertices will have their correct distances.

i) Asymmetric links: Most of the wired networks rely on the symmetric links which are always fixed. But this is not a case with ad-hoc networks as the nodes are mobile and constantly changing their position within network

ii) Routing Overhead: In wireless ad hoc networks, nodes often change their location within network. So, some stale routes are generated in the routing table which leads to unnecessary routing overhead. [8]

iii) Interference: This is the major problem with mobile ad-hoc networks as links come and go depending on the transmission characteristics, one transmission might interfere with another one and node might overhear transmissions of other nodes and can corrupt the total transmission.

iv) Dynamic Topology: Since the topology is not constant; so the mobile node might move or medium characteristics might change. In ad-hoc networks, routing tables must somehow reflect these changes in topology and routing algorithms have to be adapted. For example in a fixed network routing table updating takes place for every 30sec. This updating frequency might be very low for ad-hoc networks.

An efficient implementation of congestion routing protocol is shown here for minimizing the congestion and for the better transmission efficiency between the source and node. First there is a implementation of bypass path to avoid the congestion at first place, then there is a implementation of congested path that will get recovered after some time. At last there is comparison of total time required to get to the destination. This will also decide the transmission efficiency of the message.

IV.PSEUDO CODE

1 initialize graph
Bellman-ford (vertices V, edges E, source vertex srv)
For each **v** in **V**
{
If **v** = **srv**than d[v] =0
Else d[v] = infinite
Cost[v] = null
}
2. Relaxation of edges
For i form 1 to IVI-1

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```
{
For each [u,v] with w in E
{
If d[u]+w<d[v]
{
If d[v]=d[u]+w
Cost[v] =u
}
}
}
```

3. Checking negative cycle

```
For each e(u ,v) with weight winE
{
If d[u]+w,d[v]
{
Print "graph has negative cycle"
}
}
```

This project has following phases

1. Primary Route Discovery

The sender discovers the route to the receiver in a simple way. It broadcasts an REQ packet toward the receiver. The receiver responds to the first copy of REQ by sending back an REP packet. The REP will traverse back the path that the REQ previously followed. This path becomes the primary route between the sender and the receiver. Nodes along this route are called primary nodes. REQ A route request message is transmitted by a node requiring a route to a node Every REQ carries a time to live (TTL) value that states for how many hops this message should be forwarded. This value is set to a predefined value at the first transmission and increased at retransmissions. Retransmissions occur if no replies are received. Data packets waiting to be transmitted (i.e. the packets that initiated the REQ). Every node maintains two separate counters: a node sequence number and a broadcast_ id. The pair <source address, broadcast ID> uniquely identifies a REQ. REP A route reply message is unicasted back to the originator of a REQ if the receiver is either the node using the requested address, or it has a valid route to the requested address. The reason one can unicast the message back, is that every routeforwarding a REQ caches a route back to the originator.

2. Bypass Route Discovery

When the number of packets coming to a node exceeds its carrying capacity, the node becomes congested and starts losing packets. A variety of metrics can be used at a node to monitor congestion status. For instance, technique based on the percentage of all packets discarded for lack of buffer space, the average queue length, the number of packets timed out and retransmitted the average packet delay, and the standard deviation of packet delay. In all cases, rising numbers indicate growing congestion. The proposed technique for congestion monitoring is 'Early Congestion Detection Technique'. A Mobile Ad-Hoc Network (MANET) is a temporary network; the mobile devices in an ad-hoc network are communicating through wireless links without any pre-existing infrastructure. The one major problem of this network is network congestion; it may take place at any intermediate nodes when data packets are traveling from source to destination. [15].The congestion occurs in mobile ad-hoc networks due to limited availability of resources. In such networks, packet transmissions suffer from interference and fading, due to the shared wireless channel and dynamic topology. Transmission errors also cause burden on the network due to retransmissions of packets in the network. Recently, there has been increasing demand for support of multimedia communications in MANETs. Congestion in a network may occur at any interval, when the number of packets coming to a node exceeds its buffer capacity, the node becomes congested and starts losing packets. There are variety of metrics at a node to monitor congestion status. For instance, based on the percentage of all packets discarded for lack of buffer space and the average queue length. Using an early congestion detection technique at a node to detect the congestion well in advance.

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An early congestion detection technique is a queue management algorithm with an optimization of random early detection (RED) model that makes use of direct measurement congestion status well in advance in a network [10].

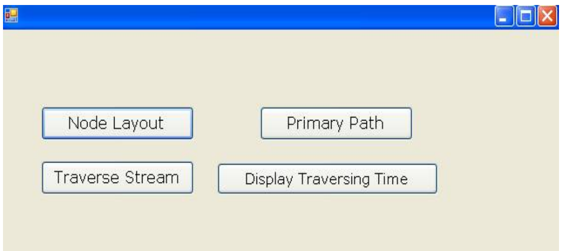
3. Congested Path Recovery

This is the normal shortest path from source to destination. In this case there will be no bypassing method as well as the technique of early congestion monitoring. In this case hop by hop message is transmitted from source to destination. When the buffer size of the node is over 50% then that node will blink as yellow, but in this case rather than bypassing we will use the same path and wait for the node to become congestion-free. This is the normal transition behavior of the message from source to destination. As that congested node becomes non-congested after some time interval the message starts its transition from source to destination. However, the total timing required for the transition of the message is more than that of bypassing the node. [14]

4. Result Analysis

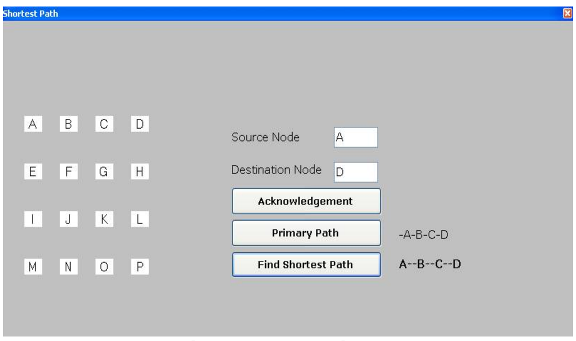
This is the last step of the system in which the comparison in terms of graph will be done on the basis of total timing calculation of transition of each packet from source to destination. From this result it can be identified that the timing required for the congested path recovery is more than that of bypass path. Thus bypass path increases the throughput of the system.

V. SIMULATION RESULTS



Screenshot : Control panel of system

This is the control panel of our system
Node Layout:- This will decide the node layout of our system.
Primary Path:-This will decide the primary path of the system.
Traverse Stream:- This will decide the further implementation of the system.
Display Traversing Time:- This will display the total time taken by congested as well as bypass path.



Screenshot : Traverse path system

This shows the source and destination nodes.Acknowledgement is for the nodes are the valid nodes or not.It will find out then the Primary path &Shortest path respectively.

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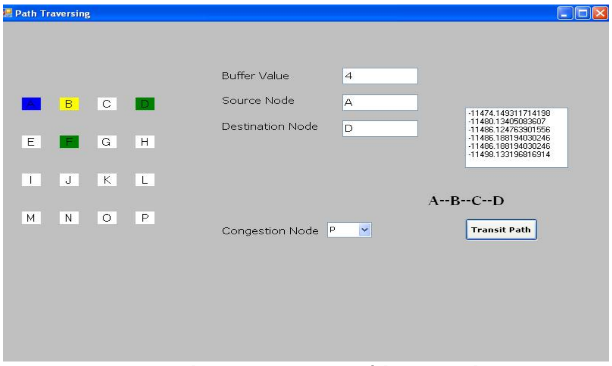
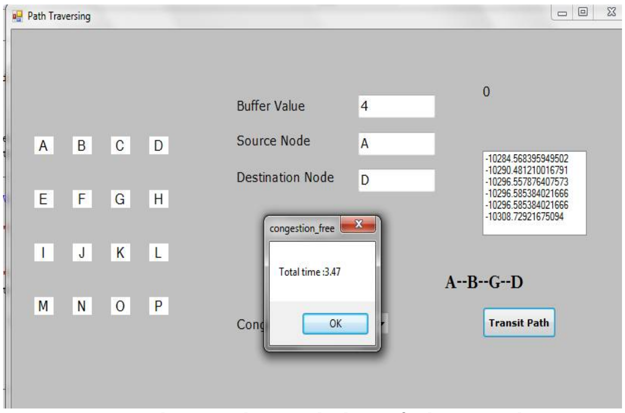


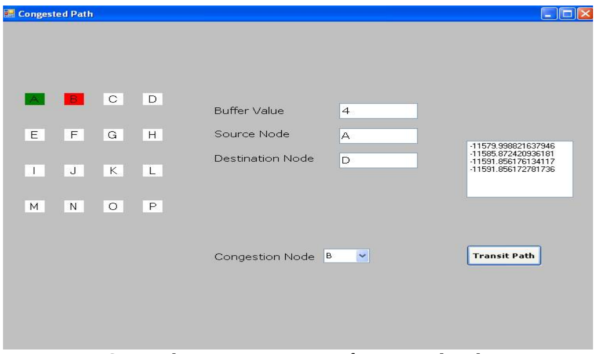
Screenshot : Transmission of bypass path

This is the traversing path screen which will pass the message step by step from source to destination.
When the particular node seems to be congested in future it will blink yellow & the system will find bypass route to eliminate the congestion ahead.It will also count the timing of transmission of each message.



Screenshot : Total time calculation for bypass path

This Screenshot display the total time required to complete the transmission by using bypass path.



Screenshot : Transmission of congested path

This is the congested path screen, in which the node which is prone to be congested is getting totally congested by showing red blink.It also count the time of each transmission.

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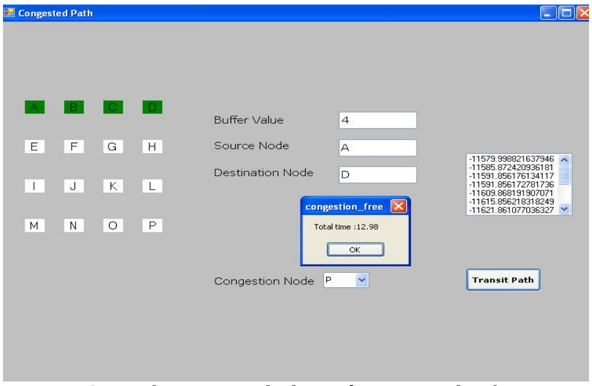
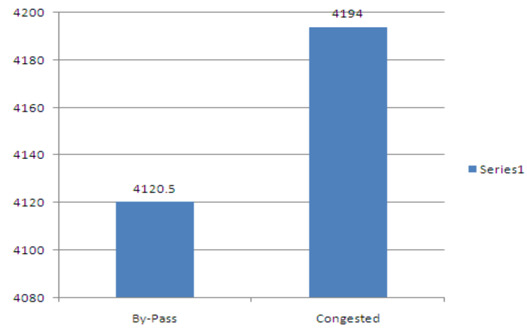


Screenshot : Time calculation for congested path

After congestion gets cleared normal transmission takes place from source to destination.



This screen shows the graph between the time taken by congested and bypass path.The time taken by bypass path for transmission is always less as compared to the congested path.This is the final result of our simulation.

VI.CONCLUSION AND FUTURE WORK

This work initiatesa congestion-adaptive routing protocol for MANETs. A key in CRP design is the bypass concept. A shortest path also provides exact transmission route with the help of distance vector protocol. A bypass is a sub-path connecting a node and the next non-congested node. Part of the incoming traffic will be sent on the bypass, making the traffic less, that is coming to the potentially congested node. The bypass path which is based on ECDT works effectively. The result of the simulation shows that whenever congestion occursthe transmission time required by congested recovery is greater than that of bypass path. Bypass path in CRP can effectively minimize the congestion as a result.

By implementing this protocol the overall throughput of the system can be enhanced.The system can work more efficiently if error correction and error recovery techniques would be developed.As most of the networks would be ad-hoc in future this protocol gives them efficient solution for routing.By developing the protocols that can trace the exact behavior of changing topology more efficient routing can be possible.

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