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# Network Performance using Multipath Congestion Segmentation in Mobile Ad Hoc Networks

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**Abstract:** The mobile ad hoc networks are subjected by its autonomous topology with restricted medium bandwidth and constrained energy at the nodes. Due to these features in mobile ad hoc networks, the routes linking the source node and targets might become very uneven and as such, the transmissions in mobile ad hoc networks is quite intricate. For addressing these problems, we design a multi-path congestion segmentation algorithm. Here preliminarily diverse split routes are identified and the information packets are communicated along the routes which fulfill the limitation in routing such as bandwidth, delay and route constancy. In case if the routes do not fulfill the restrictions, the congestion could be dispersed along the diverse split paths with the help of congestion segmentation routine. Inflence of the different parameters drived using mathematical expression and simulation graphs reveals that the designed scheme minimizes the packet dropping and also minimizes the delay with the enhanced output.

**Keywords:** Mobile Ad Hoc Networks, Bandwidth, Energy, Segmentation, Throughput and Delay

## 1 Introduction

The mobile ad hoc networks is a collection of wireless nodes with the ability to generate a network without any need of prevailing networks because the networks do not have any positioned planning or installation. The mobile network is gaining its attention immensely due to the increasing demands. In order for a node to interchange information packets among one another, it transfers them to other nodes through several links [1]. The transmission among these non-administered networks basically comprises fast multi-hop broadcasts where the autonomous nodes acts as routers for performing these broadcasts with no planned installation. Each and every node has the ability to relocate them arbitrarily and these nodes are regarded as being. The nodes have the ability to communicate the information to the random source and target. Therefore every node has the ability to perform as a source, target or a router. The key merit of the network is an immediate arrangement of unplanned network and it has the ability to provide diverse facilities. The employment of these networks is helpful in disasters, battlefields, hospitals and multimedia domains. Also, the possible setback is quite intricate to preserve real-time congestion like audio and video during the presence of autonomous network topology because of the immense ratio of pre-requisite and extreme-delay limitations [2].

### *1.1 Weight-Equalized Routing*

The weight equalization is a scheme where prevailing multi-path attempts to transfer information packets from autonomous nodes with adequate residual abilities. Therefore the capable local traffics could be restrained and in parallel it elevates the proportion of communication with vigorously modifying weights within the network. Because of weight equalization, the complete network outcomes can be possibly elevated and an improved QoS could be attained. Within the networks all the routes hold similar bandwidth. In weight equalization, the router forwards the information packets to the target using the initial route, the subsequent information packet to the identical target over the subsequent routes. The weight equalization assures similar weight across diverse routes. With the aid of weight equalization within the network, it is probable to allocate weights among diverse routes for acquiring best

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possible resource consumption, reducing the time of reply, increasing outcomes, improving the lifetime of the network and evading overload. The usage of weight equalization in diverse routes escalates the consistency through severance [3,4,5].

### 1.2 Multi-Path Transmission

The routing in mobile ad hoc networks could be categorized based on the nodes and the number of routes prevailing within the networks. i.e. single-path routing and multi-path routing. Single-path routing is the routing standard where a single path offers more than one path for forwarding the information from the source node to target node within the network. With the help of multi-path routing the weight equalization and liability leniency could be attained. The multi-path routing focuses on installing the multi-paths among the source node and target nodes. There are diverse multi-path routing schemes prevailing. For instance, there are routing schemes offering several routes among the source node and target node termed as momentarily-arranged routing scheme. The DSR offers a privilege to the nodes for employing substitute paths [4,6,7]. The below listed schemes are the ones aiding multi-paths.

The split multi-path routing is a scheme offering utmost route splits. The paths within the network are explored based on the need i.e. during the source node forwarding a demand message to the overall nodes within the network. Based on the demand message the target locates diverse route splits and forwards a reply message to the source for each and every separate route. Hence the scheme calculates the associations and the split routes.

The AOMDV is a routing scheme entailing a substitute route in each and every demand message with reply among the source and target node within the network. Here all the routes hold the information related to the hop computation for each and every target i.e. the utmost path is calculated along with the hop variances among the nonstop routes and substitute routes.

The AODV multi-path is a standard for calculating diverse node split routes. Here the in-between nodes communicate the demand packets to the target. The target answers, all the demands focusing on increasing the number of anticipated several routes within the network. The reply packets are sent to the source node with the help of opposite paths negotiated by the demand packets. Hence the scheme creates only single-split routes. There is no restriction on the utmost path counts.

### 1.3 Benefits of Multi-Path Communication

Within the network, the transmission among the nodes could be useful in times of split paths in multi-path communication. Here the path is damaged and the routing scheme still holds. The nodes within the network are autonomous and also have autonomous behavior along with inferior wireless association quality, the nodes among the source and target could make use of this path as a tailback and preliminary paths. All these information packets could be used to identify several routes. As a result, it is probable to improve the lifetime of the network and to improve the weight equalization. The multi-path routing holds some key advantages like lenience ability, improved combination of prevailing bandwidth and weight equalization. It is probable to astound the problems such as traffic and blockage within the network. The effectiveness of the network is improved by offering path stability. It is evident that the bandwidth of the nodes is restricted within the network and also the single route might not offer adequate bandwidth for routing. The combination of diverse routes pleases the bandwidth pre-requisites and acquires minimal delays [6,7,8].

### 1.4 Problems in Multi-Path Communication

Usually, in mobile ad hoc networks, the key problem employs multi-path routing schemes. It is because several routing standards disperse the congestion into preliminary paths. The routing does not offer load equalization because during the breakdown of information packets by the preliminary paths it gets re-located to the subsequent paths within the network since load equalization is not acquired. Moreover, during the problems in exploring bandwidth and delay-limited routes, the congestion could be scattered among diverse split routes [9].

It is noted that there prevail some routing standards which divides the flow of congestion among the source and target effectively. During route failures, alternative routes forward the information packets to the target.

### 1.5 Congestion Excruciation

The division of congestion is a crucial segment in multi-path routing which denotes a scheme of scattering the information packets of a specific node in several routes within the network. The best possible scheme is to employ a nonstop split routes. Based on the congestion segregation within the network, it is likely to minimize the video space incidences which are created due to node displacements and enhances the quality of the acquired video information packets. In congestion segregation within the network, it is likely to minimize the delays among the source and target nodes and also in regulating the network traffic. With the help of this segmentation, there is a huge upsurge in concurrent communication i.e. improved outcomes could be acquired and minimizing latencies. The segregation of congestion to several paths within the network could offer an improved weight equalization, improved combination and error leniency along with enhancing the resource consumption within the network and bandwidth optimization [10,11].

## 2 Addressed Disputes

From all the prevailing schemes, it is evident that the intention is to implement a multi-path constant QoS routing for real-time congestion in mobile ad hoc networks. Here several split routes are identified between the source and target. Based on the identified paths the best possible paths are chosen in terms of bandwidth limitations, delay limitation, and route constancy. Upon acquiring the demand the mobile communication is preliminarily classified as present and non-prevailing communication with improved precedence. For real-time communication, the bandwidth and delay-restricted routes are selected. For practical communication, the fixed routes are selected. The focus is to offer weight equalization for real-time application with the help of congestion segmentation.

## 3 Related Works

The intention is to design a multi-path routing with the help of network coding or not for enhancing the consistency and strength. The multi-path routing standards use a space-based severance within the networks by inserting repeated data for enhancing the strength in duplicating with medium or association faults because of displacements. Moreover, the network coding introduces supplementary information-determined packets on several routes which could make routing effective. The autonomous routing method acclimates routing to medium conditions. The scheme reveals that the delivery ratio and behavior nearer to several route experiences minimized overheads as compared to the multi-path in an improved medium or association fault conditions [12].

The focus on the improvement of DSR standards for offering improved provisions to video torrent distribution. The designed scheme intends on the path identification. The packet segmentation scheme and the defensive path identification process is employed. A substitute parameter termed as video irritation is employed for calculating the space in videos in a precise and direct manner. An autonomous scheme for increasing the extent of splits in successive routes for the similar torrent increases the performance of the scheme in comparison to the prevailing schemes.

The focus is on designing k routing scheme for estimating the routes for lining up delay-based congestion dispersion which permits the source to forward the information to the target in mobile ad hoc network. The scheme of congestion dispersion could improve the dependability of the network which offers weight equalization and reduced delays. The results depict that the segmentation of congestion works well than the minimal path routing in terms of weight equalization, dependability within the network and in reducing the overall delays within the networks.

The aim is to use of multi-path routing for escalating the flexibility besides the network breakdowns or enhancing the safety in mobile ad hoc networks. The OLSR scheme is modified by diverse multi-path routing schemes. The DM-OLSR scheme intends to resolve the incomplete perception of the network topology, flooding interruption assaults and weight equalization in multi-path OLSR-based networks. Here the nodes choose their MPSR with added attention during the topology identification and performing analysis of split routes during path estimation state. The key benefit of the scheme is to enhance the flexibility against network breakdowns or vulnerable outbreaks.

The focus is on weight conscious routing parameter based on the airtime association expense parameter which aggregates the congestion calculated from the MAC layer. For increasing the weight equalization a weight conscious routing parameter is designed for multi-path routing scheme. The key benefit is the quality of the routing parameters which employs path identification for addressing the issues prevailing with traffic and blockages.

## 4 Designed Scheme

The congestion segmentation in terms of multi-path routing is a scheme for dispensing the information packets of a particular torrent in several routes. Dividing the congestion to diverse paths could offer improved weight equalization, fault lenience, and improved comprehensive bandwidths. The segmentation of congestion could be helpful in minimizing the traffic, blockages and reducing the mean delays, and that also enhances the consumption of network resources. The congestion segmentation is employed in below-stated conditions.

In case if the bandwidth and delay-restricted routes could not be identified then the weights could be scattered along several split routes.

In case if there is a traffic or overload prevailing, within the communication and in between node then the congestion segmentation is activated. The dispersion of congestion to several paths is based on the constancy and path expenses.

**Extreme Path Segmentation Algorithm**
If
No route is selected earlier then select the initial minimal route
Else
Locate the minimal node split routes

If
Not prevailing
Then
Locate the minimally associated split route
If
Not prevailing
Then
Locate the minimal route with smallest mutual associations
If
Not prevailing
Then

### *4.1 Select initial minimal routes*

The intention is to locate the splits in a single oath which is performed relatively based on the formerly-employed paths. The scheme effortlessly adjusts to added paths identified using the transmission or interruption of routing packets along with the paths that are not missed. The key intention of the scheme is to locate the best selection in every condition which cannot be regarded as costly for small-scale systems for which a suitable scheme is designed.

### *4.2 Congestion Segmentation*

The optimal scheme in terms of congestion segmentation is the usage of minimal split routes. More commonly node split routes are recommended because they achieve improved transaction in terms of bandwidth and node supplies. There are some conditions where no node split routes are prevailing and hence associated split routes are employed. The association split is adequate to minimize the consequences of displacements in mobile ad hoc networks. In order to describe a parameter, the precise outcomes in terms of congestion segmentation employing average extent of route splits are analyzed.

### *4.3 Congestion Segmentation on Multiple Routes*

Consider a route r(r = 1, 2,... , n) where the r$^{th}$ route is designed as a network. For instance congestion with average incoming rate $\varphi$ prevails in between the origin and target node the congestion is divided into split routes. The congestion along the path is ‘$C_r$’. The sharing of congestion ‘$C_r$’ is entailed as,

$$\Sigma C_r = \varphi \tag{1}$$

In case if the congestion among the multiple routes and the dispersion of congestion lines up the delays then there is a reciprocal association prevailing among the distribution of congestion and delay in a specific route.

If ‘$C_r$’ is the congestion assigned to a route there r = 1,2,... .., n then

$$C_r \alpha \frac{1}{d_r} \quad \text{and} \quad \Sigma_{r=1}^{m} C_r.$$

Here in the above equation ‘$C_r$’ is the congestion prevailing in the route and ‘$d_r$’ is the delay of that specific route.

$$d\Sigma_{r=1}^{m}\frac{1}{d_r} = \phi \tag{2}$$

The above equation ‘$\delta$’ is the mathematical constant and ‘$\varphi$’ is the average incoming rate.

$$d = \frac{\phi(d_1, d_2, \ldots, d_m)}{d_2, d_3, \ldots, d_m + d_1, d_2, \ldots, d_{m-1}}$$

$$C_1 = \frac{\phi(d_2, d_3, \ldots, d_m)}{d_2, d_3, \ldots, d_m + d_1, d_2, \ldots, d_{m-1}}$$

Lastly, the ‘$C_r$’ is congestion assigned on the route which is represented as,

$$C_r = \frac{\phi(d_2, d_3, \ldots, d_{r-1}, d_{r+1}, \ldots, d_m)}{d_2, d_3, \ldots, d_m + d_1, d_2, \ldots, d_{m-1}} \tag{3}$$

From Figure 1 it is evident that the origin communicates

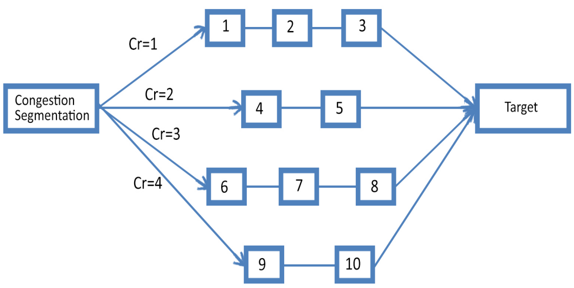


**Fig. 1:** Route discovery in congestion segmentation

the information packets to the target. These information packets are communicated from the origin to the target using segmentation. It is evident that the congestion is divided at the source node and the congestion is divided based on the estimated assigned congestion ‘$C_r$’ for a specific route within the network. For instance consider the estimated congestion within the route is $C_1 = 1$, $C_2 = 2$, $C_3 = 3$, $C_4 = 3$ for the routes.

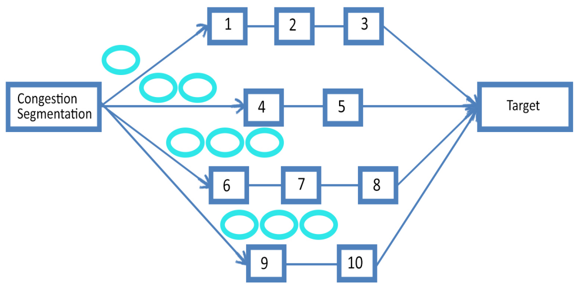


**Fig. 2:** Information communication in congestion segmentation

Based on the estimation congestion assigned, the origin forwards the information packets in accordance with the congestion values. From Figure 2, it is evident that it is possible to monitor the origin communicates three information packets on route 3 and another three information packets on route 4 based on the acquired traffic assigned values. This way the information packets are segmented into the entire network. Based on the dispersion of the information packets within the networks, it is likely to communicate the information packets to the target without negotiating the limitations.

### 4.4 Congestion Segmentation Routine

Step 1: Primarily to accomplish congestion segmentation within the network several paths are located.
Step 2: For identifying several paths within the networks, there is a focus on features such as bandwidth, delay and route constancy.
Step 3: Soon after locating diverse paths among the source and target the information packets are segmented to satisfy the routing pre-requisites within the network.
Step 4: The congestion segmentation aids in estimating the assigned congestion based on Eqn. 3.
Step 5: In the same manner, the congestion segmentation of the information packets fulfills the limitations within the network.

## 5 Performance Analysis

For evaluating the performance of multi-path QoS routing standards for congestion segmentation, it is performed using network simulator. Here 1000 x 1000 square meter regions are employed where the nodes make use of constant broadcasts. The network makes use of 50 nodes for analysis and the volume of medium for autonomous nodes is initialized to 2 Mbps. Here CBR congestion is employed for analysis. Table 1 depicts the metrics employed for analysis.

The analysis is performed by evaluating the designed multi-path congestion segmentation scheme with the multi-path coded scheme. The evaluation is performed as described below. From Figure 3 it is clear that the network throughput of the designed congestion segmentation and multi-path coded scheme is depicted where the designed scheme chooses the routes based on the bandwidth and it disperse the congestion among several routes. But the network throughput is 60% improved than the conventional multi-path coding scheme.

**Table 1:** Simulation Parameters

| | |
|---|---|
| Nodes | 50s |
| Size of the area | 1000 $\times$ 1000 sq.m |
| Time of Simulation | 50s |
| Congestion | CBR |
| Speed | 5,10,15,20 and 25 Mbps |
| Rate | 250Kb |
| Size of Packets | 512 |

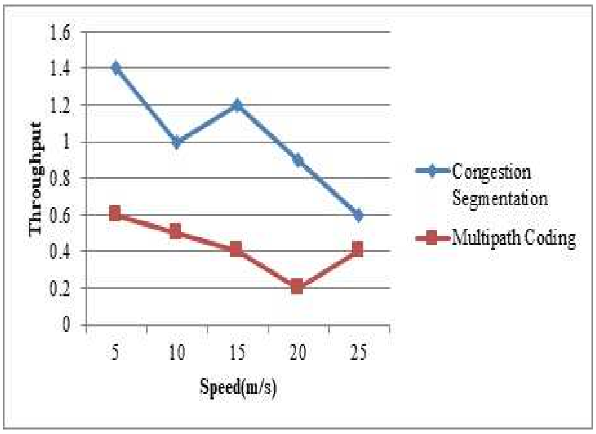


**Fig. 3:** Throughput

Figure 4 depicts the delays of the designed congestion segmentation scheme and multi-path coding scheme. It is evident that the multi-path coded scheme utilizes utmost time and acquires 75% of increased delays as evaluated against the congestion segmentation scheme. Furthermore, the delay parameter is considered for route choice in congestion segmentation which holds minimal delays within the routes.

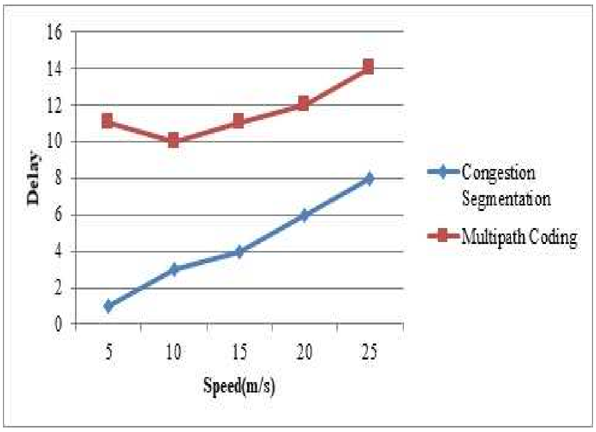


**Fig. 4:** End-to-End delays

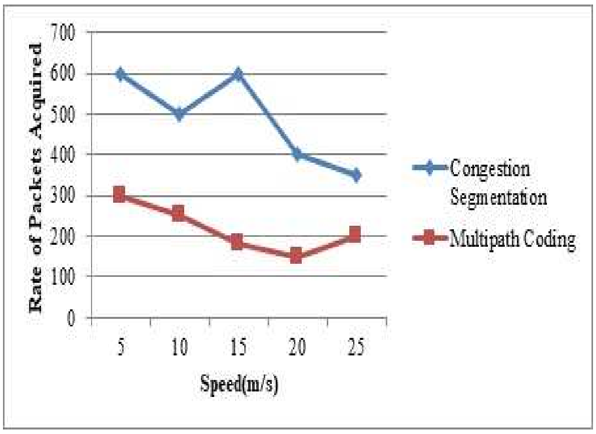


**Fig. 6:** Packets Acquired

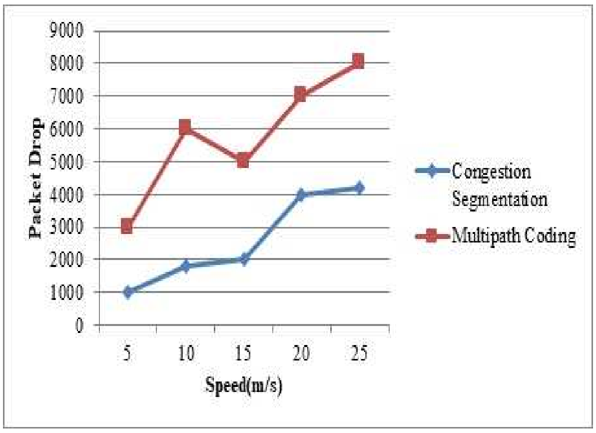


**Fig. 5:** Packet Drop

Figure 5 depicts that the packet drop is experienced for both the congestion segmentation and multi-path coding scheme. The congestion dispersion of the designed scheme equalizes the weight along the routes and reduces the packet drops.

This is the major reason for congestion segmentation to acquire 60% of minimized drops as compared to the multi-path coding scheme.

Figure 6 depicts the rate of packets arrival for congestion segmentation and multi-path coding scheme. It is evident that the designed scheme acquires 60% more packets as estimated against the multi-path coding scheme and it is because that the designed scheme chooses the routes based on the bandwidth and constancy.

## 6 Conclusion

The intention is to design a multi-path congestion segmentation scheme for mobile ad hoc networks. Here primarily the network desires to communicate the information packets using the route which fulfills the limitations prevailing in routing like bandwidth, delay and constancy within the network. In case if the route does not fulfill the limitations then the congestion could be dispersed among the diverse split paths with the help of congestion segmentation routine. The results of simulation reveal that the designed scheme minimizes the packet drops and delays with enhanced throughput for applicable and non-applicable congestion.

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