International Journal of Scientific & Engineering Research, Volume 6, Issue 5, May-2015 1445
ISSN 2229-5518

Enhancement of Fair Distribution of Bandwidth over Mobile Ad hoc Networks

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Abstract--A wireless ad hoc network is a collection of two or more devices or nodes or terminals with wireless communications and networking capability that communicate with each other without using any existing network infrastructure. It requires an effective bandwidth distribution which is described as maximum throughput in a communication system. A bandwidth is the total distance between the highest and lowest signals in a communication channel which is distributed in such a way that, it is overused by nodes near gateway and scarcely used by nodes far away from gateway. To avoid this problem of unfairness and data loss due to high mobility, this paper anticipated a fair share algorithm in which the bandwidth is fairly distributed in order to avoid the packet losses in terms of data transfer in the channel dynamically. Efficiency is affected by some factors like throughput, packet transmission and latency. Due to fair distribution of bandwidth in the network, efficient transfer of packets can be achieved.

Index terms- MANET, Bandwidth, Fairness, Efficiency.

1 INTRODUCTION

MOBILE AD HOC NETWORKS (MANETs) are very intricate accumulation of wireless mobile nodes that can be self-organized and self-administrated networks where the nodes can move arbitrarily in dynamically ephemeral [1] network topologies. Ad Hoc Networks are complex distributed systems that consist of wireless mobile or static nodes that can freely and dynamically self-organize and adaptive [2]. In this, a special node, gateway is used to connect to Internet, so that the packets generated in ad hoc network can be relayed to Internet. Figure 1 represents a mobile ad hoc network.

MANETs needn't bother with extravagant or wired base to bolster versatility. Notwithstanding their fundamental functionalities as nodes, they are functioning as switches where they course the packets of alternate nodes. One of the principle issues in such systems is execution in an alterably evolving topology; the nodes are relied upon to be power-aware because of the transmission capacity obliged system, vitality limitations and constrained security.In cell systems, there is a system base spoke to by the base-stations, Radio system controllers, and so on. In impromptu systems each correspondence terminal (or radio terminal RT) speaks with its accomplice to perform distributed correspondence. On the off chance that the obliged RT is not a neighbour to the initiated call RT, (outside the scope region of the RT) then the other intermediate RTs are used to perform the communication link. This is called multi-hop shared correspondence. This coordinated effort between the RTs is essential in the impromptu systems.

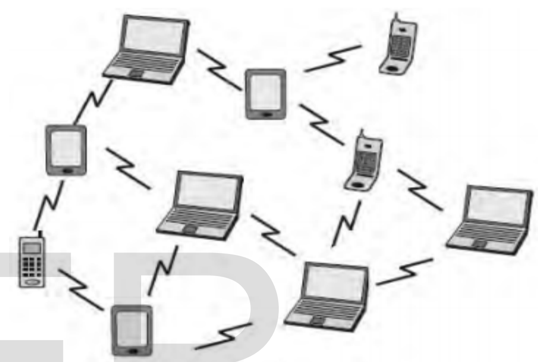

Fig 1: Mobile Ad Hoc Network

In specially appointed systems all the correspondence system conventions ought to be conveyed all through the correspondence terminals (i.e. the communication terminals should be independent and highly cooperative). Efficiency and fairness are the two major factors generally users want to achieve. Efficiency refers to the network channel capacity that should be used at most. Fairness refers to the property that all the links must get assigned bandwidth in a fair share manner.

Following are the applications of MANETs [3],

- Military or police exercises.
- Disaster relief operations.
- Mine site operations.
- Urgent Business meetings.
- Personal Area Network.

Following are the pros of MANETs,

- They provide access to information and services regardless of geographic position.
- These networks can be set up at any place and time.
- These networks work without any pre-existing infrastructure.

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Following are the cons of MANETs,

- Limited resources.
- Limited physical security.
- Intrinsic mutual trust vulnerable to attacks.
- Lack of authorization facilities.
- Volatile network topology makes it hard to detect malicious nodes.
- Security protocols for wired networks cannot work for ad hoc networks.

Transmission capacity assumes an imperative part in different system advances. Different applications can get profited by knowing the qualities of data transfer capacity in the system way. System bearers for the most part plan limit redesign in their own particular system which is in view of the rate of expansion of transmission capacity usage of their clients. Data transfer capacity is likewise is a fundamental thought in content distribution networks, intelligent routing system, end-to-end admission control, and audio-video streaming [6].

The most widely used medium access control (MAC) protocol in ad hoc networks is IEEE 802.11 and is based on random access and thus lacks the ability to manage bandwidth allocation. The Internet has made due without nature of administration basically by expanding the limit of its connections to take care of demand. A wireless ad hoc network does not have this extravagance power (particularly for battery-powered equipment) and bandwidth is precious, and interference is harder to manage.

The decentralized and dynamic nature of ad hoc networks implies that data must be gone from node to node about the system topology and end-to-end flow rates. Moreover conveyed transfer speed allotment calculations are for the most part supported over brought together ones. Two key criteria of any such distributed algorithm are the amount of data passed from node to node and the convergence time of the algorithm (to what extent it takes to achieve a relentless state after an annoyance) [4].

A third criterion is the fairness of the algorithm. The bandwidth allocation issue considered here is the accompanying. A network of nodes and (wireless) connections is indicated. At any case in time, there are various end-to-end flows. Every flow has its own required bandwidth. In the extraordinary situation where a node is avaricious and needs to use however much bandwidth as could reasonably be expected, its desired bandwidth can be set to infinity in the accompanying algorithms. Every node must focus the bandwidth to allocate for each flow passing through it in a fair and efficient way.

A bandwidth allocation algorithm must work over the MAC and network layers of the convention stack. The system layer is in charge of end-to-end flow rate estimations, while the MAC layer must schedule single-hop transmissions in order to guarantee every flow gets adequate bandwidth over each link.

2 RELATED WORK

Dynamic bandwidth provisioning in networks has as of late pulled in a great deal of examination consideration because of its planned to achieve effective asset usage to network clients. The quick development in expanding prerequisite of the quality of service oriented architectures that suitably enhance the framework functionalities and its overall performance are being invented and developed [6]. In wireless systems, nodes are normally regarded as half-duplex; they cannot transmit and receive information simultaneously. Additionally, because of the dynamic nature of ad hoc networks, nodes go back and forth; a typical assumption is that all nodes transmit Omni-directionally and at the same frequency [4].

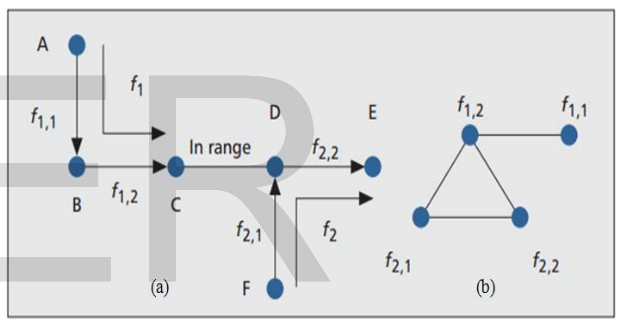

Fig 2: Illustration of Rate of Flow in a Network
(a) Topology graph (b) Flow contention Graph

Rate allocation schemes vary in objectives, approaches, and performance. Max-min fair, increasing the rate of one flow would cause another flow, already having an equal or lower rate, to decrease further. Multi-hop flows are broken into multiple independent single-hop sub-flows. When max-min fair allocation for single-hop sub flows is calculated, the rate for sub flow f1, 1 is larger than that of f1, 2 [4] as in figure 2. However, since sub flows f1,1 and f1,2 are both part of flow f1, if the rate of f1,1 is larger than f1,2, packets from f1,1 will accumulate and cause congestion at node B. If a reliable transport protocol such as TCP is adopted, the rates of f1,1 and f1,2 will stabilize to the same value; that is, f1,1 would not be able to achieve its allocated rate, and in other network topologies this may cause bandwidth to be wasted that could otherwise have been used by another flow. As the end-to-end throughput determines the quality of service perceived by users, we

ISSN 2229-5518

believe it is more reasonable to allocate rates to end-to-end flows [4].

The goal is to maximize the sum of all flow rates (subject to the constraint that every flow is ensured a basic fair share of the spectrum. The issue is defined as a con) subject to the imperative that every flow is ensured a fundamental decent amount of the range. The problem is formulated as a constrained optimization problem for the entire net work and comprehended by an algorithm in a centralized way. An alternate approximate optimal solution is proposed for the distributed manner of operation.

Pricing has demonstrated its efficiency long back when connected to wire-line networks. To adopt the price-based approach [4], utility capacities are utilized to portray the asset necessities and the level of fulfilment of individual clients.

Different pricing structures and utility functions can lead to different algorithms, some better suited to distributed operations than others. Cautious decisions of utility functions [4] allow proportional fairness or max-min fairness to be achieved. Nonetheless, the proposed iterative algorithm has a relatively high computational complexity and a relatively long convergence time, which might limit its applicability.

Changes in the topology just happen on much larger timescales than the time needed for the algorithm to converge to a fair allocation. These plans may perform well with static flows; nonetheless, their exhibitions under element flow conditions have not been concentrated on. These plans may perform well with static flows. The system layer does not unequivocally compute the reasonable rates. The reasonable rates are resolved certainly through a two-stage mechanism, which in essence, starts by transmitting packets in a round-robin fashion so that all flows receive the same rate, and then reduces the transmission rates for those flows experiencing congestion.

Distinctive nodes transmit at diverse frequencies, that is, just transmissions having a common node meddle with one another. Two-stage mechanism [4]: List these flows with the goal that they can be analyzed in a round robin style. Towards the beginning of every time space, the node examines the next flow on the list. On the off chance that the quantity of pending packets for this flow at the upstream node or downstream node essentially surpasses the quantity of pending packets for this flow at the present node, this flow is skipped and the following flow on the list considered. Otherwise, the node discharges a packet for this flow; the packet is presently pending transmission.

Most rate allocation schemes oblige the flow rates to be changed instantaneously in response to feedback information from the network a primal-dual congestion controller is proposed which overhauls the flow rates slowly to copy the reaction of TCP to congestion feedback. In MAC protocols, once the network layer has ascertained the data rate to which every end-to-end flow is entitled, a mechanism is needed in the MAC layer for controlling the entrance of single-hop flows to the medium so as to guarantee every flow gets its entitled data rate. Such mechanisms usually belong to one of two types: contention based or cooperative.

Every node having a packet ready for transmission endeavours to transmit that packet with a probability called the persistence probability. (Setting the persistence probability to one debilitates this mechanism.) Should a collision happen (another node endeavours to transmit a packet in the meantime), every node included in the impact will wait for a certain (possibly random) amount of time, called the back-off time, before attempting retransmission.

Algorithm attempts to achieve a fair bandwidth allocation based solely on the levels of congestion each node sees. This means it is not possible for end-to-end fairness to be achieved in general. Fair share of bandwidth can be achieved by implementing fair share algorithm where the packet loss in the network can be minimized by scheduling it from time-to-time, checking the active nodes and the availability of the bandwidth, so as to increase the throughput of the network.

3 SOLUTION AND PROSPECT

The bandwidth that can be allocated to the nodes in a network is 1GBps (estimation), which is to be uniformly shared between the nodes present in the network and also to those nodes which gets connected in the network. A fair distribution of bandwidth is being done for loss tolerance. The network consists of n nodes, in which one acts as a server and the other 'n-1' act as clients, in which the bandwidth is fairly shared so that the packet loss is reduced. The administration of a network might be central or distributed. In a central network, among the nodes present in a network, a node acts as a hotspot. In distributed environment, the nodes present in a network are spread such that a node among certain number of nodes acts as a cluster head (CH) and for these CHs, certain amount of bandwidth is being allocated such that, that bandwidth is fairly distributed among the nodes of that CH.

The network might be static or dynamic. In a static network, the fair share of bandwidth can be achieved as the number of nodes in the network can be easily measured. By using this, the bandwidth that is to be allocated to the nodes can be calculated. It differs in the case of dynamic network. As there is a problem with scheduling and former algorithm, the nodes which are inactive also gets the bandwidth being allocated in the network, efficiency of the network is abased.

A fair share algorithm is used to achieve fairness in the network. In this fair share algorithm, in an attempt to provide the fair share of the bandwidth, a timer is being used which checks the drastic changes in the number of nodes present in the network, and calculates the number of active nodes and the bandwidth which is to be allocated to each node. Here is an estimation of bandwidth that is to be allocated to each node when it is found that the node is active. By using this, when an i^{th} (say) node is found active, the differences in the usage of bandwidth for the node previous, 'i-1' and next, 'i+1', to it is calculated.

Lingering bandwidth is being added to the total bandwidth of the network which can be used for the further nodes in the network, so that the total bandwidth will not be wasted in the network, the bandwidth can effectively used, which improvises the throughput. As the bandwidth is fairly shared among the nodes, the packet loss will be abridged. The results shown in the next section will reveal the empirical values.

4 RESULTS

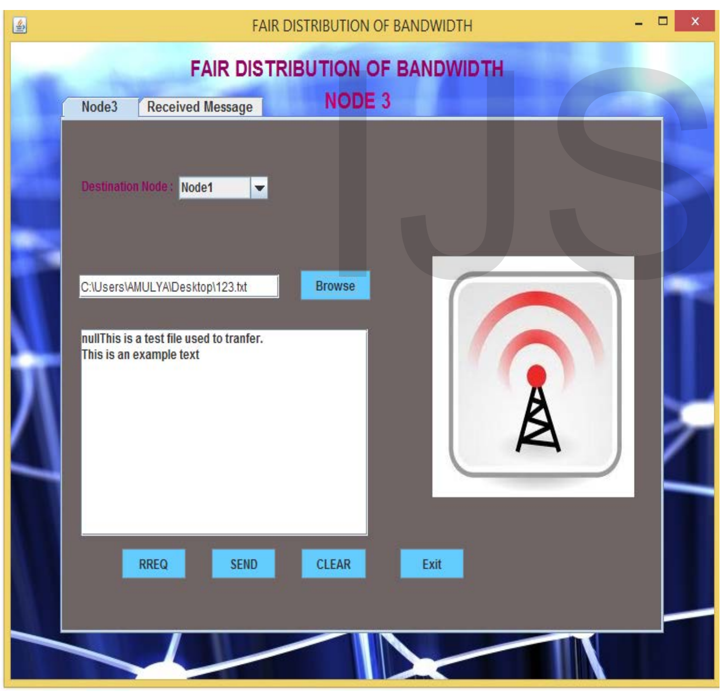

Fig 3: Node

In figure 3, the Node (Source Node-Node3 here) is being flaunted, which constitutes the selection of node (destination node-Node1 here), to which it should transfer the data in the form of packets and the data in the packet is flaunted here. CLEAR clears the fields. EXIT closes the window. Received Message tab will receive the message when sent by any other node.

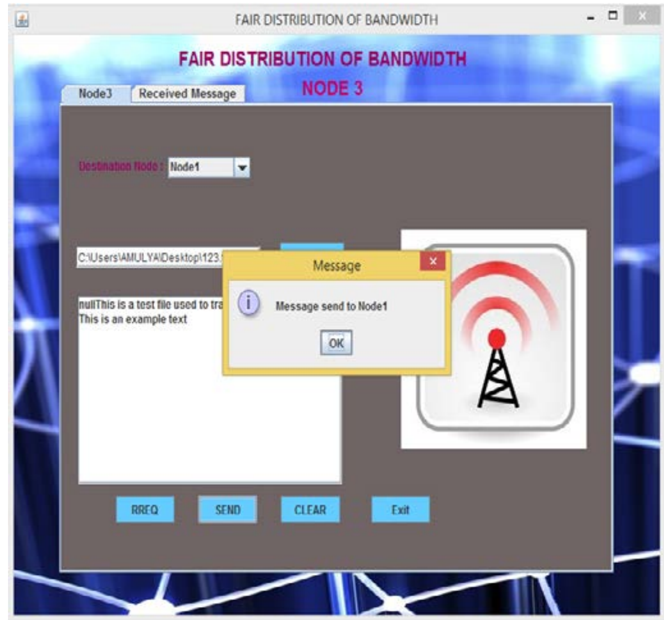

Fig 4: Sending Message to Destination Node

In figure 4, on click of RREQ, the path from source to destination is discovered and set, so that the file required is being transferred in that path. On click of SEND, the data is sent to destination node and a message "Message send to Node1" is popped.

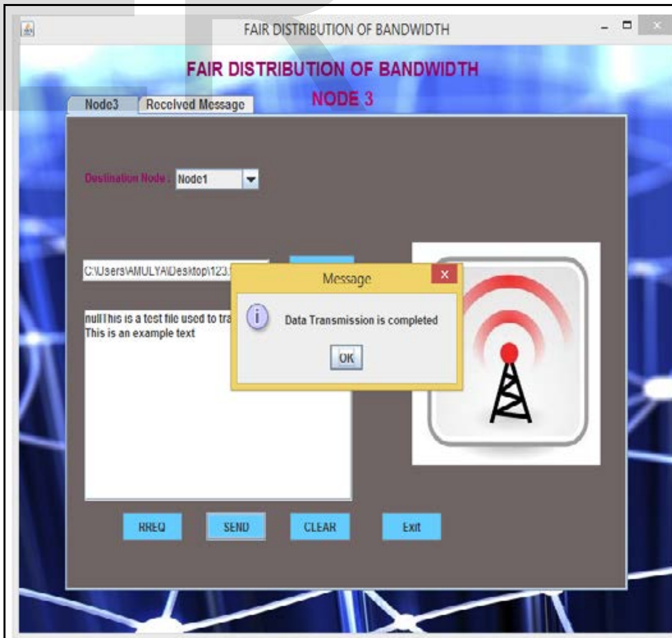

Fig 5: Data Transmission completed

In figure 5, after sending the data, the total transmission is completed at the source end and a message “Data Transmission is completed” is popped.

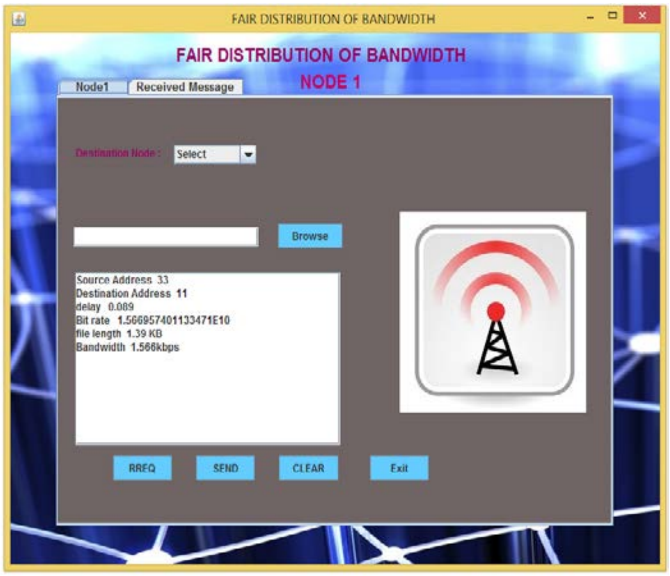

Fig 6: Destination Node

In figure 6, at the destination end the above mentioned details are computed and flaunted. Here the Source Address, Destination Address, delay, bit rate, file length, bandwidth are computed.

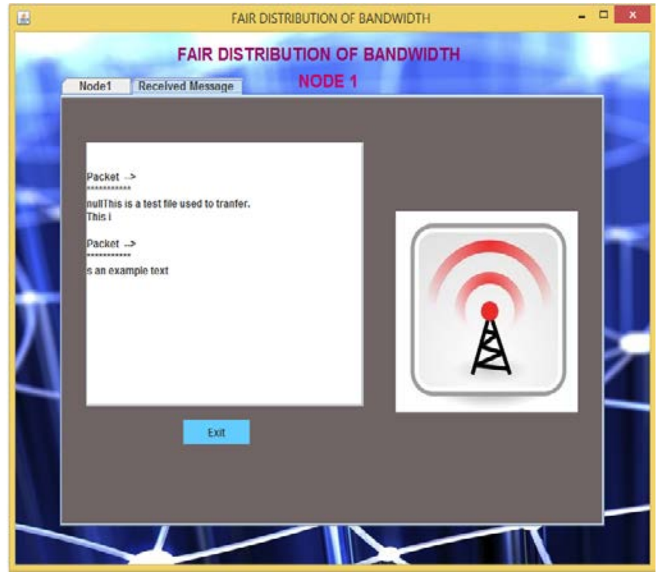

Figure 7: Received Message

In figure 7, the data which is transferred from Node3 to Node1 is flaunted packet-wise; whose size is 48 at the destination end.

5 CONCLUSION

The current work gives the bandwidth which is being fairly shared in an ad hoc network by using a fair share algorithm in which the total bandwidth present in the network is fairly distributed among the nodes in the network, so that the packet loss gets reduced and the efficiency of the network is augmented.

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