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Bandwidth Allocation and Routing Information for Wireless Mobile Ad-hoc Networks

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***Abstract* - An admission control Algorithm must organize among flows and should afford assurance of how the medium is shared between nodes. In a wired network, nodes can keep an eye on the medium to see how much bandwidth is being used by the network. On the other hand, in an Ad-Hoc network, during communication nodes possibly will use the bandwidth of neighbouring nodes. Consequently, the bandwidth consumption of flows and the accessible resources to a node are not local concepts, other than it being linked to the neighbouring nodes in carrier-sensing range. Current solutions do not address how to perform admission control in such an environment so that the admitted flows in the network do not exceed network capacity. Here I present an application to demonstrate how the bandwidth is shared between nodes and the effectiveness of admission control framework to support QoS in Ad-Hoc networks.**

Key Words — Mobile Ad-Hoc Networks (MANETs), Quality of Service (QoS), Bandwidth Allocation (BW)

I. INTRODUCTION

An Ad-Hoc network is a collection of wireless mobile hosts forming a temporary network without aid of any centralized administration or standard support services regularly available on the Wide Area Network (WAN) to which the host may normally be connected [1]. Mobile Ad-Hoc Networks has a new structure in the field of wireless communication network.

The technology gives the user a freedom to move freely any were in the communication range and it has become independent of its infrastructure. This freedom from existing infrastructure has made Mobile Ad-Hoc Networks (MANETs) more flexible, affordable and easily deployable in all environments including military and rescue operations, particularly disaster relief operations in areas void of communication infrastructure [2], [3].

Mobile Ad-Hoc Networks are of two major categories, they are (1) Proactive Protocols and (2) Reactive Protocols. In proactive protocol approach the idea is to keep track of the routes from a source to all destinations in the network. This approach requires periodic exchange of routing information among the nodes and consequently these protocols show minimal delay when the route is required [4]. In reactive protocol approach, the concept of acquiring information about routing is used only when needed. An advantage is that smaller bandwidth is needed for maintaining routing tables. The approach avoids large overheads due to maintaining routes between all possible source and destination pairs [4], [5]. The remainder of this paper is organized as follows. In section 2, I present a few related works relevant to my research work. Section 3 talks about the bandwidth management system. The goals of my research work are explained in section 4 and section 5 explains the application and some of my results. I conclude my work with future work in section 6.

II. RELATED WORK

Each time a route is used to forward a data packet, its Active Route Lifetime field of the source, destination and the next hop on the path to the destination is updated to be no less than the current time plus ACTIVE_ROUTE_TIMEOUT. Since the route between each originator and destination pair is expected to be symmetric, the Active Route Lifetime for the previous hop, along the reverse path back to the IP source, is also updated to be no less than the current time plus ACTIVE_ROUTE_TIMEOUT. The lifetime for an Active Route is updated each time the route is used regardless of whether the destination is a single node or a subnet [6].

Purpose of this new protocol is it modifies Ad-hoc On-demand Distance Vector (AODV) to improve its performance. With a simple modification in applying the mechanism of carrier sense in IEEE 802.11b, the proposed routing protocols can achieve better packet delivery ratio, normalized routing load, and end-to-end delay [7].

The effect of network population and different network usage patterns is on control overheads and that consume a considerable amount of network bandwidth. The proposed dynamic route caching based solution is to reduce the overheads in static scenarios [3].

Analysis of bandwidth utilization and routing delay in MANETs are subjected to prolong static environments and suggests a provision of dynamic route cache in AODV routing protocol. The behaviour of AODV routing protocol for fixed networks and those exhibiting low mobility with a view to highlight the reasons for this shortfall in the performance of AODV and in the end we propose suitable enhancement for making up this deficiency [8].

In AODV, instead of building routes for all possible destinations in the network, a node only creates and maintains routes that it really needs. Although this on-demand approach minimizes routing table information and greatly reduces the amount of unnecessary route management overhead, it potentially leads to a large number of route requests being generated, and as a result, the increase of traffic exchange delay. The results show that the improved AODV further decreases the routing overhead, thus resulting in better performance in terms of latency and routing protocol efficiency [9].

The simulation results show that the Optimized-AODV could also be suitable if overall routing load or if the application oriented metrics such as delay and packet delivery ratio are important consideration for the Ad-Hoc network application. Optimized AODV is recommended as a better protocol especially for large Mobile Ad-Hoc Networks [10].

A Mobile Ad-Hoc Network (MANET) is usually power constrained due to the limited battery energy on each node. For MANETS, energy efficiency is crucial for the design of new routing protocols. In this paper, a new energy-aware routing algorithm, called Energy Saving Ad-hoc On-demand Distance Vector (ESAODV) routing, is proposed. In the route discovery process of ESAODV, intermediate nodes estimate the Current Average Energy of the Network (CAEN) as a comparison threshold to determine how to respond to the Received Route Request (RREQ) packets. After that, the effects of ESAODV on network performance are addressed. Analytical and simulation results show that the proposed ESAODV can effectively protect the energy-overused nodes and can greatly prolong the network lifetime[11].

III. Bandwidth Management System

This kind of system in my application brings up the effective management of bandwidth which provides transmission range to transfer the packets of data between several nodes within the network. In this system I am going to provide a clear explanation of the network characteristics, the architecture of the bandwidth system and the communication protocol which helps to provide the communication between the nodes in the network.

A. Network Model

The bandwidth management network system categorized as several computer systems and network devices on the network MAC layer. In this application I am going to use laptop computers which are pre configured with 802.11 interfaces and I assume that every single node in the network is within the transmission range of every other node present in the network. As a result only one single node will be in the transmission mode where other nodes will be present in the network however these will be brought into the service when the bandwidth for single node fails to send the required packets. As per the [12] base station determines the transmission in the network and actually manages the transmission between the nodes and responsible for the communication. The node transmission and the channel are always in reverse proposition and this means when the channel is busy, the node will be disabled to transfer the data. This is because node is particular in data overriding. This kind of collisions can be avoided if the mechanism of binary exponential back off is present in the system, these collisions may occur when the nodes transfer the packet of data at a time or at random times. As well, every node in the network are directly connected which means transfer of packets can be done from one node to another node in the transmission range without the presence of base station as an intermediate carrier.

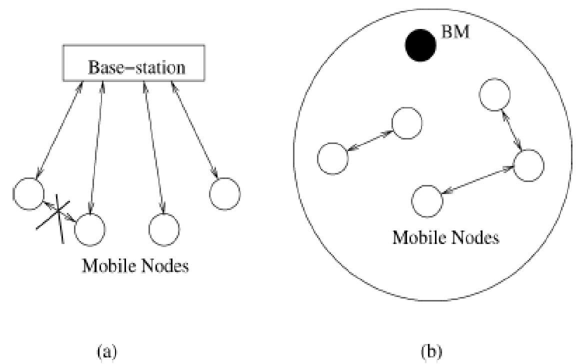


Fig 1 Comparison of network models: (a) base-station model, (b) single hop Ad-Hoc network model.

The above diagram compares the two network models where sequenced from left are the base-station model where the base station is central manager to manage the transmission and the followed model is the proposed one in which each node will be directly connected to (peer to peer), represents Ad-Hoc nature of wireless network. Base station has the full control of network related issues but not in the proposed wireless network. In this system bandwidth problem makes it a bit difficult as there is no presence of any central managing server as like in base-station model.

This application needs one computer system to implement the Bandwidth Manager (BM) program where in my case I am going to use laptop which acts as the host for the bandwidth manager program. The port number and IP Address of the bandwidth manager system can be easily identified with the help of famous scheme called service discovery mechanism [13], [14]. When this bandwidth manger program is not available for service due to some network problems or packets crash or mobility problems the newly adopted efficient algorithm called election algorithm which will enable the new one after the time out of the old one. But in the base-station network model they also adopt the single Ad-Hoc network but without peer to peer communication between the nodes in the network. However the recent wireless networks adopt both base-station and single Ad-Hoc networks (802.11) which will overcome the network issues.

In the main two streams in these wireless networks uplink and downlink streams are considered as two separate single Ad-Hoc flows and the channel transmission time will be decided by bandwidth manager. In the base-station network model the bandwidth manager locates at the base station itself, but in this application I am interested in single Ad-Hoc and peer to peer communication.

B. Bandwidth Management System Architecture

In this architecture I am going explain how the flow between the node and bandwidth manager takes place. Each and every flow has unique identifier and will be registered with the bandwidth manager before it starts transmitting the packets. This identifier is known as flow-id and contains the source IP address, source port number, destination IP address and destination port number.

The flow f should have the minimum bandwidth B min (f) and the maximum bandwidth B max (f) specified before it actually starts transmission. It should have estimation of total network bandwidth Bp (f), during the registration with bandwidth manager and the flow will be notified with minimum and maximum CTP requirements P min (f) and P max (f). These values can be obtained from B min (f) and B max (f). So as a result and in reply to these measures the bandwidth manager authenticates the values of flow (f) and includes it to the group of flows called set F.

Then this can be used as part of the transmission to transfer the packets. Along with this the bandwidth manager allocates a proper channel time Pa (f) to the set of flows which will make use of this time to communicate with the nodes and calculate the transmission rate. The flows in the channel should be friendly and communicate each other properly or else that particular flow will be detected and removed.

The above architecture consists of 3 major components: the Rate Adaptor (RA) at the application or middleware layer, the per-node Total Bandwidth Estimator (TBE) at the MAC-layer and the Bandwidth Manager (BM), which is unique in the entire single-hop wireless network.

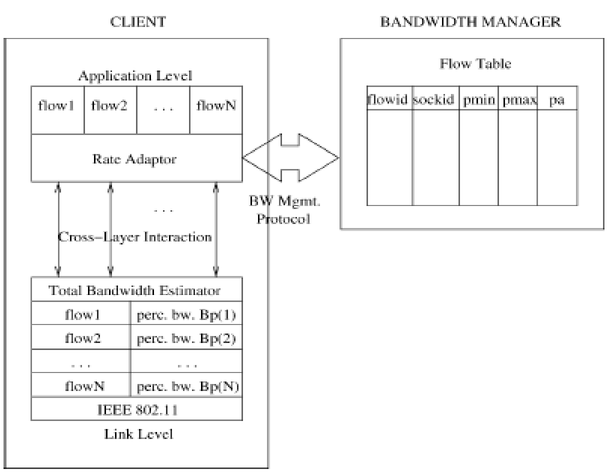


Fig 2 Bandwidth management system architecture

C. Rate Adaptor (RA)

This Rate Adaptor (RA) converts the bandwidth requirements into CTP requirements and sends it across to bandwidth manager for the CTP requirements. As soon as it sends the CTP requirements, it controls the transmission rate of each flow which actually based on the requirements.

To keep it less expensive, this rate adaptor configured into the UDP application itself and this RA can be implemented separately so that it can be attached or linked to the application dynamically. This is so that it acts as a middle layer just below the application layer to control the application traffic [15].

D. Total Bandwidth Estimator (TBE)

This part of bandwidth management system architecture is coupled with IEEE 802.11 at MAC layer of network. Basically it calculates the total network bandwidth and is described as the total bandwidth of the network at a particular instant of time. Rate Adaptor (RA) avoids contacting BM for bandwidth violation. However RA is perfect in large bandwidth violation where it negotiates with BM to prevent any bandwidth violation in each flow f.

E. Bandwidth Management Protocol

This is the major part of the bandwidth management system architecture, where it allows all network components communicate each other and provides flow of transmission within the node. It mainly connects the components of the bandwidth management architecture to the BM. "The BM is invoked at the time of flow establishment, flow teardown, significant change in a flow's perception of total bandwidth, or significant change in a flow's traffic pattern" [16].

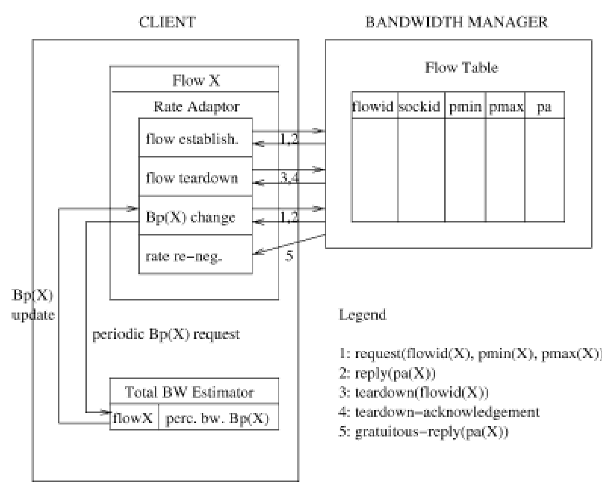


Fig 3 Bandwidth management protocol

IV. GOALS

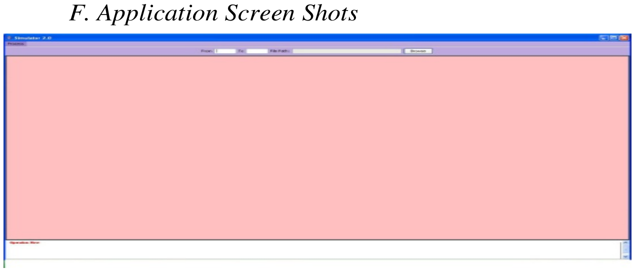
The advancement in wireless communication has facilitated the development of mobile Ad-Hoc networks. The various applications for such networks involve the use of multimedia data which necessitates Quality of Service (QoS) support for better communication. The primary objective of our research is to present an effective and scalable admission control protocol intended for wireless Ad-Hoc networks to enable end-to-end connections satisfying QoS requirements. The QoS requirements provide applications which gives assurance in provisions such as delay, bandwidth or jitter. The assurances can be provided in networks in such a way that the resource allocation in individual nodes are provided by MAC layer where as the resources used in the various route of communication are considered by the network layer. The objective of providing wireless Ad-Hoc networks with such requirements has various challenges such as predicting the available bandwidth and bandwidth consumption. To assign a constant amount of bandwidth for most excellent effort traffic but this does neither take into account the resources which is necessary for the advantaged traffic nor the topology of the network. Such explanation frequently leads to a sub-optimal use of the network resources. The presentation gain of the obtained solution should be considerably increased compared to the solution which is provided earlier.

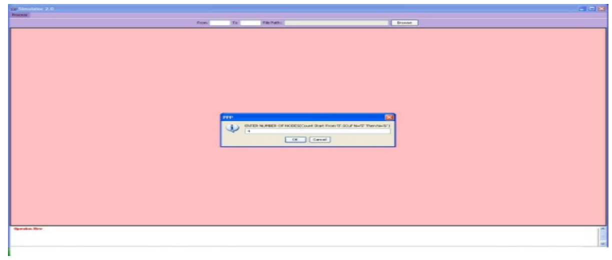
V. Application

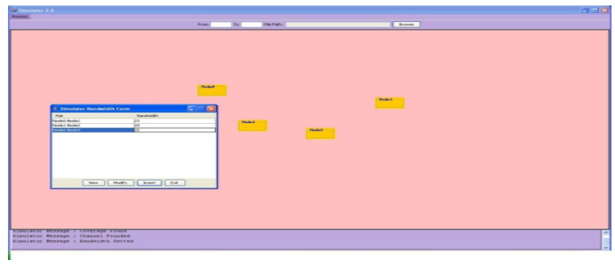
I have explained the application for the multiple Ad-Hoc networks. You can see some of the screen shots on my application demo. I created an application using JAVA to show how the nodes and created and also the bandwidth splitting for neighbouring nodes. It also shows how the bandwidth is allocated between nodes and how it is splitting between nodes. In my application I have created an applet simulator window, in which we can create number of nodes we needed and after this we can allocate the bandwidth between each nodes by selecting the process tab, and there opens a small window to insert the bandwidth between two nodes.

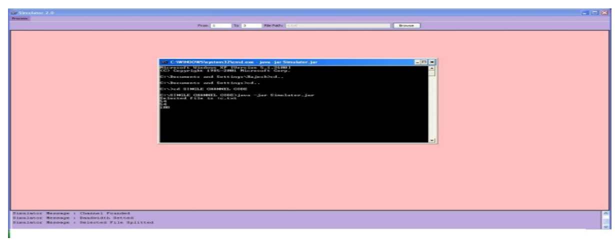
After doing this, it should be given that from which node to which node the file is transferred. Now the file which is going to transfer is selected by browsing. It is selected from the data folder and after this we can see at the bottom of the applet window which shows the operation of this process and also we can see the bandwidth splitting on the command window. Additionally I am using encryption and decryption technique in this project. I am using RSA Algorithm for this method. I have allocated separate folder for the encrypted file and decrypted file to store.

F. Application Screen Shots









VI. Conclusion and Future Work

In this paper, it is very important that the information from nodes should include during the transmission (i.e.) carrier sensing and all other outside transmission range throughout the admission control process. It is theoretically demonstrates the operation of the Content Aware Admission Protocol, also shows the request for the bandwidth away from the different networks. In future it can be combined with various accessible protocols such as QoS-aware MAC protocols or end host policing protocols. Here in this I am using an additional method with this, the encryption and decryption technique. This method can also be used in those existing protocols and it can be implemented in future. When we use dissimilar QoS Aware MAC protocol and also different admission protocols, it may affect the bandwidth of local available bandwidth. On the other hand Content Aware Admission Protocol method for performing local available bandwidth by using C-neighbor must not be affected. Here in this I have created an application using java and shown how the bandwidth is splitting between nodes. It is clearly shown that, in a wireless networks each and every node can freely make a decision about their traffic which enters into the nodes during the bandwidth consumption and also in their C-neighbors. So in order to get a solution with no difficulty in a network, I have focused on an estimated solution. In my future work, it is planned to develop an algorithm for Bandwidth allocation and to implement in OPNET. I am also focusing on cross layer design optimisation integrating MAC layer with upper protocol layers. The idea is to develop a novel solution to solve the MANET bandwidth problems

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