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Secure Dynamic Bandwidth Allocation to Reduce Rerouting Time in MANET

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Abstract—MANET refers to mobile ad-hoc networks in which the nodes are constantly in motion. Consequently there are many link breaks and frequent network partitioning which leads to failure of transmitting packets to the destination. The nodes therefore have to reroute the packets to retransmit the packets to the destination. Moreover the nodes have to perform all the functions themselves and their resources get drained. In MANETS it is essential to preserve resources like bandwidth. By shifting the bandwidth allocation functionality to a third party node, the overhead of the other nodes can be reduced to a considerable extent and it can focus on rerouting the packets faster. This third party node also ensures that bandwidth is not wasted and the transmission takes place with as minimum bandwidth requirement as possible. This saves bandwidth that can be used by other traffic. Moreover the transmission nodes do not have to worry about bandwidth allocation as it is taken care of by third party node. Hence the transmission nodes only have to reroute the packets using the available routing protocols designed for MANET. Consequently the time taken to reroute the packets is reduced.

Keywords— bandwidth, TTPA, QoS, rerouting time, MANET

I. INTRODUCTION

Wireless networks have widely gained popularity in the past few years. Wireless networks have become inevitable in our everyday lives. Infrastructureless networks are also known as ad-hoc wireless networks or mobile ad-hoc networks (MANET). These networks comprise of only the communicating nodes which are mobile in nature. The MANET nodes are intelligent nodes. The mobile nodes are intelligent in that they solely perform the routing process, rerouting process, data transfer, bandwidth allocation, route computation etc. Because these nodes perform all the functionality in addition to just the data transfer and communication, they experience additional overhead. Therefore optimization is of prime concern for the efficient functioning of a mobile ad-hoc network. One primary concern is bandwidth allocation. In ad-hoc networks bandwidth is allocated dynamically. Bandwidth management is the method of measuring and mainly restraining the communication traffic on a link in order to avoid completely using the bandwidth to its maximum capacity or overloading the link. Bandwidth allocation has been a great challenge to achieve to provide Quality of Service in ad-hoc wireless networks. It is of primary importance especially in ad-hoc wireless network that the resources such as bandwidth should be utilized efficiently. Each node functions independently of the other node and therefore makes independent decisions on how to use the resources such as bandwidth. It has to be ensured that bandwidth is not utilized to its fullest or bandwidth capacity should not be exceeded. Moreover security is also a big challenge faced by wireless networks. Security can be achieved by using robust cryptographic methods in order to ensure integrity, authenticity as well as confidentiality. This project aims to provide secure and efficient bandwidth utilization that can be applied in general to MANETS by employing a node that functions as a Trusted Third Party Allocator (TTPA). The time taken to reroute packets to the destination will significantly reduce if the bandwidth allocation is already taken care of by another node for the network. So this reduces overhead of the other nodes and they can route and reroute packets significantly faster.

II. LITERATURE SURVEY

An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it. In the paper “Bandwidth Allocation and Routing Information in Wireless Ad-Hoc Networks”, [1] reference was made on how the transmission medium is shared between the nodes of ad-hoc wireless network. This paper provides a bandwidth management system for efficient bandwidth utilization. Efficient bandwidth utilization is a challenge in wireless networks because the nodes in wireless network clog the channel with flooding control packets in case of reactive routing protocols for example or continuously broadcast routing table information to the rest of the nodes in the network in the case of proactive approach, thereby making unnecessary wastage of the network bandwidth. The paper “Agent based Bandwidth Reservation Routing Technique in Mobile Ad-Hoc Networks” proposes an agent-based bandwidth allocation mechanism in which the status of every nodes bottleneck bandwidth [2] is collected and the node transmits packets through the most favorable path i.e. minimum cost, congestion and network

bandwidth. After updating the bottleneck bandwidth of the destination node the data packet is redirected back to the source. Bandwidth reservation is done on the basis of the comparison of the available bandwidth and this bottleneck bandwidth. If the bottleneck bandwidth is lesser than the available bandwidth the bandwidth reservation is said to be done. The paper "Current and Future Applications of Mobile and Wireless Networks" [3] is in favor of the remarkable functionality and affordability of wireless networks and focuses on the emerging applications of various types of wireless networks such as cellular networks, wireless LANs, GPS networks, Satellite-based PCS, Ad-Hoc networks and Wireless Sensor Networks. The paper "Bandwidth Allocation in Ad-Hoc Networks: A Price Based Approach" [4], makes use of a pricing scheme in bandwidth distribution. Due to the limited availability and cost of resources such as bandwidth and battery power, the nodes tend to selectively forward its own traffic and be reluctant to relay other nodes traffic to save bandwidth and to prevent hindering the transmission of their own traffic. Therefore this paper contains a study of the pricing scheme employed by nodes which offers a price or incentive to other nodes for their traffic to be forwarded.

The paper "Intelligent Routing and Bandwidth Allocation in Wireless Networks" [5], expand swarm based technology to ad-hoc wireless networks. Swarm based technology is based on intelligent biological behavior of swarms of insects, that gather together in count of thousands and autonomously communicate together to accomplish certain tedious tasks. The same concept is applied in wireless networks so that nodes autonomously communicate to achieve bandwidth allocation and routing in an intelligent way. The paper "Bandwidth Estimation in Mobile Ad-Hoc Network" [7] provides the estimation techniques of the network bandwidth using two methods: Hello bandwidth estimation and Listen bandwidth estimation. In the former technique the hosts "listen" to the channel and derive when the bandwidth is free or available. In the latter technique the sender's bandwidth consumption information as well as the sender's one hop bandwidth consumption information is piggybacked onto a "Hello" packet and each host performs an estimate of its bandwidth consumption and available bandwidth based on the information provided in the hello packets. Yet another paper depicts a method of fair bandwidth allocation using max flow [9].

III. BANDWIDTH ALLOCATION

In ad-hoc networks bandwidth is allocated dynamically. Bandwidth must be allotted in a shared transmission medium on demand (as and when required) and fairly among the users of the medium. Bandwidth allocation is influenced by the nature of the traffic and the instantaneous traffic demands of the nodes. Bandwidth can be efficiently used in cases when all the nodes are not connected to the transmission channel at one time; or even when connected, nodes are not using the channel at all times; or in cases when traffic occurs in burst (i.e. traffic is not continuously transmitted over the medium completely utilizing the bandwidth, there are gaps between transmission packets freeing the bandwidth so that those gaps can be filled by traffic of other nodes). Bandwidth management is the method of measuring and mainly restraining the communication traffic on a link in order to avoid completely using the bandwidth to its maximum capacity or overloading the link. This is essential in order to prevent network congestion and prevent the network from performance poorly. There are several mechanisms that are employed for management of bandwidth:

Traffic shaping (rate limiting): Bandwidth can be reserved by a method called traffic shaping which is a method that delays some or all of the data packets (or datagram) in order to bring them in conformity with a particular traffic profile. The two most common types of traffic shaping are route-based traffic shaping and application based traffic shaping. Two most common used algorithms for traffic shaping are token bucket and leaky bucket algorithms which are employed in packet switched networks and in telecommunication networks to ensure that transmission packets adhere to the stipulated limitation on the bandwidth and burstiness of traffic (a measure of unevenness or variation sin traffic flow).

Scheduling algorithms: In order to avoid competition for the bandwidth by all network traffic thereby clogging the channel, several scheduling algorithms are used based on nature and priority of network traffic [8]. Some of these are Weighted Fair Queuing (WFQ), class-based Weighted Fair Queuing, Weighted Round Robin (WRR), Deficit Weighted Round Robin (DWRR), and Hierarchical Fair Service Curve (HFSC).

Congestion avoidance: Congestion avoidance techniques are employed in order to monitor network traffic in order to prevent network congestion. Mostly this is achieved through packet dropping. Some techniques used are Random Early Detection (RED), Weighted Random Early Detection (WRED), Explicit Congestion Notification (ECN), and buffer tuning.

Bandwidth Reservation Protocols: There are several bandwidth reservation protocols that are employed to reserve bandwidth. One most common of them is Resource Reservation Protocol (RSVP). This protocol works at the transport layer and aims to reserve resources across the network for integrated services. RSVP can be implemented either by hosts or by routers, to reserve resources for specific traffic based on priority, to request or deliver the specific levels of QoS to the application data or packets. RSVP allows applications to use the resources mainly bandwidth only when needed and relinquish (surrender) the resources once their need is fulfilled. RSVP requires for each node along the path to perform resource reservation. RSVP itself is not a routing protocol. It is designed to interoperate with other routing protocols to reserve bandwidth and other resources.

IV. PROPOSED SYSTEM

The proposed system employs a node called Trusted Third Party Allocator (TTPA) that performs secure bandwidth allocation among the nodes of the MANET. Keeping bandwidth utilization as minimum and efficient as possible allows the node to reserve bandwidth for future traffic transmissions. In the proposed system security is also provided by this Trusted Third Party Allocator by providing security keys. The time taken to reroute the packet will significantly reduce if the bandwidth allocation is performed by another entity. This project attempts to reduce bandwidth wastage and allocate

bandwidth dynamically and securely so that the net rerouting time taken for a node to reroute the transmission packet to the destination will be reduced in the event of a link failure.

Keeping bandwidth reservation as minimum as possible leads to reduced energy requirements and leaves more bandwidth for reservation by other nodes in the future. In addition to this the nodes have to only calculate rerouting path in the event of link failure, thereby reducing rerouting time.

The functionality of this system is to employ a node called a trusted third party allocator (TTPA) as the node that will provide for secure efficient dynamic bandwidth utilization. In events where node failure takes place a cluster concept is used where the functionality can be migrated to a secondary TTPA. In most simple implementation of fault tolerant TTPA it can consist of a two node cluster. The product function is to reduce rerouting time in a MANET in the event of a link failure by providing for secure dynamic bandwidth allocation using a Trusted Third Party Allocator node (TTPA). This system comprises of the following modules: node creation, security module Trusted Third Party Allocator (TTPA) sender, and destination. In this module a node is constructed and their values are stored in the database. Node details are given as input during node creation such as name (Node 1, Node 2 etc. or Node A, Node B etc.); associated IP address of the node, the connection of the node with the other nodes i.e. which nodes are connected to the nodes in question. Node construction is done in discretion so that no duplicate values of nodes are created. Then source and destination node are identified.

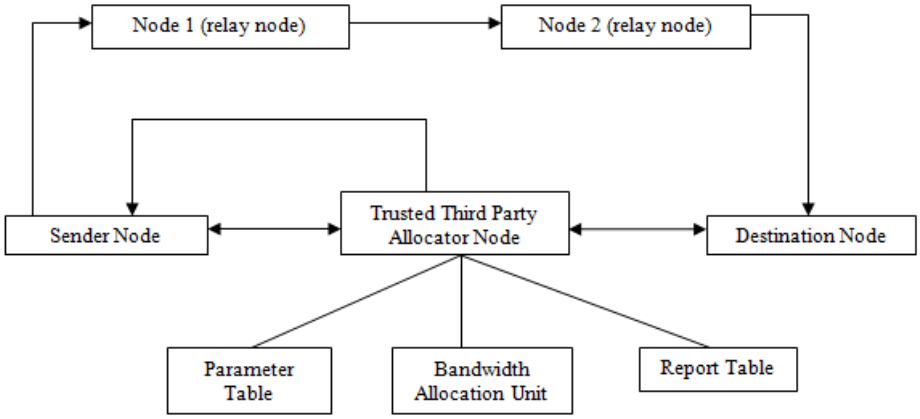

FIG 1. ARCHITECTURAL DIAGRAM OF THE PROPOSED SYSTEM

The security module provides security during packet transmission. In this project RSA algorithm is employed. RSA is a public key cryptographic system. It offers more security for data transmission because it makes use of two keys: public key and private key to encrypt and decrypt respectively the message before transmission. A node uses a key generation program to develop two keys public key and private key. The public and private keys are inversely related and it is "computationally infeasible" to derive the private key from the public key. This is the essence of the of RSA algorithm. The public key is used for encrypting the message i.e. plaintext. The resultant encrypted message i.e. cipher text is transmitted over the unreliable and insecure medium. The node can transmit the public key to other nodes who want to communicate with it. A node can encrypt the message using the public key but only the recipient who possesses the private key will be able to decipher the message. Any user can generate its own pair of public-private key pair. Though it is computationally easy to produce public-private key pairs, it is computationally infeasible to derive a private key from its corresponding public key.

The Trusted Third Party Allocator (TTPA) provides the secret key for encryption and decryption. The Trusted Third Party Allocator (TTPA) provides the secret key for encryption and decryption. In this project RS algorithm is employed. The TTPA module takes care of the bandwidth allocation. The TTPA is also a mobile node just like any other node in MANET. This node allocates bandwidth based on time and weight fairness. It allocates bandwidth efficiently to those transmission packets that arrive first. If the number of bandwidth reservation exceeds the threshold limit then the bandwidth is allocated based on priority of the service of the packets. In the sender module, the sender node selects a text or java file that it desires to send. The user reserves bandwidth through TTPA module and sends the file through the reserved bandwidth. The destination node receives the file sent by the sender, decrypts it and reads the file.

V. CONCLUSION

MANET routing protocols have to deal with frequent link breaks due to the dynamic topology and movement of nodes. This causes nodes to reroute packets to the destination. Moreover the packets contend for bandwidth which is a limited resource. Bandwidth allocation is also done by the nodes of the network itself. This causes overhead and battery drain. Therefore, moving the functionality of bandwidth allocation to another separate node known as Trusted Third Party Allocator will reduce the overheard of these nodes. Moreover the TTPA node guarantees security for the transmission data. The TTPA allocates bandwidth based on time and weight. It allocates bandwidth to the node wanting to send transmission packets based on time. After a certain time out the node will concatenate all the packets and send to the destination. If packets of different services contend for bandwidth, the received bandwidth from TTPA is reserved by the sender node for the packets based on priority. Hence this scheme reduces overhead of the mobile nodes in MANET so that the nodes can reroute the packets faster. Consequently rerouting time is reduced. The system suffers from certain

limitations. For instance efficient bandwidth allocation cannot take place if the network is highly congested. The proposed system may not give desired result when implemented along with hybrid routing protocols of MANET such as Zone Routing Protocol. It is not suitable to incorporate this system into MANETS that are deployed in military terrain and catastrophic environments. However the proposed system can be reinforced by forming a cluster of TTPA systems to deploy throughout the MANET, to provide more scalability, robustness and fault tolerance.

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