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PERFORMANCE BASED OPTIMIZATION TO MULTIPATH ROUTING PROTOCOLS IN MOBILE AD HOC AND WIRELESS SENSOR NETWORKS

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Performance Based Optimization to Multipath Routing Protocols In Mobile Ad Hoc and Wireless Sensor Networks

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Abstract – Mobile Ad hoc Networks are typically characterized by high mobility and frequent link failures. As a result, routing algorithms selecting a single path during route creation have to make frequent route discoveries resulting in decreased throughput and high end to end delay. Multipath routing approaches like AOMDV make use of pre-computed routes determined during route discovery. This solution, however, suffers during high mobility because the alternate paths are not actively maintained. Hence, precisely when needed, the routes are often broken. In this paper, the information gathered by a node about its neighbor, in addition to those proposed in , is used to dynamically determine the node to which a particular data packet has to be forwarded. Using this approach a better load balancing can be obtained in addition to utilization of the additional routes, if feasible, and in the process maintaining these routes. We also explore the possibility of implementing QoS using such a scheme.

A Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary network without using centralized access points, infrastructure, or centralized administration. Routing means the act of moving information across an internet work from a source to a destination. The biggest challenge in this kind of networks is to find a path between the communication end points, what is aggravated through the node mobility. In this paper we present a new routing algorithm for mobile, multi-hop ad-hoc networks.

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INTRODUCTION

In ad-hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner. All nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network. Therefore, routing protocols in ad-hoc networks must be adaptive to face frequent topology changes because of node mobility. Unlike conventional wireless networks, ad hoc networks have no fixed network infrastructure or administrative support. The topology of such networks changes dynamically as mobile nodes join or depart the network or radio links between nodes become unusable. Conventional wireless networks require as prerequisites a fixed network infrastructure with centralized administration for their operation.

Quality-of-service (QoS) routing in a MANET network is difficult because the network topology may change constantly and the available state information for routing is inherently indefinite. To support QoS, the link state information such as Bandwidth, Routing overhead, Average End to end Delay (AED) and jitter in the network should be available and manageable. However, getting and managing the link state information in a MANET is by all means not simple because the quality of a wireless link changes with the surrounding circumstance. Furthermore, the resource limitations and the mobility of hosts add to the complexity and.

However, the unpredictable nature of Ad-Hoc networks and the requirement of quick reaction to QoS routing demands make the idea of a proactive protocol more suitable. When a request arrives, the control layer can easily check if the pre-computed optimal route can satisfy such a request. Thus, waste of network resources when attempting to discover infeasible routes is avoided. Based on this consideration, in the paper, we study the approach of pro-active QoS routing, and study two of the most common proactive protocols (DSDV) and OLSR Protocols. And modify a best-effort pro-active routing protocol OLSR for QoS purpose. The QoS requirement studied in the study is the bandwidth constraint. Generally the Objective of this paper is to Study two common Proactive protocols (DSDV & OLSR) for secure QoS incorporation, selecting a protocol with promising performance for SECURE QOS, proposing and implementing BW aware route discovery for the selected protocol and study the performance achieved using simulation.

A Mobile Ad hoc network is an instantly deployable wireless network without any base station or infrastructure support. Because the Ad hoc networks can be easily deployed, they are used in applications such as automated battlefields, search and rescue, crowd control, and disaster management. These situations are characterized by dynamic topologies, bandwidth-constrained, variable capacity links, energy constrained operation and limited physical security.

In these scenarios, it is essential to perform routing with maximal throughput and, at the same time, with minimal control overhead. Overhead here is defined in terms of the routing protocol control messages which consume both channel bandwidth as well as the battery power of nodes for communication/processing.

The most popular routing strategy, for reducing the overhead, is on demand routing wherein the routing protocols build and maintain only needed routes. Examples include Ad hoc On-demand Distance Vector routing (AODV), Dynamic Source Routing (DSR), and Temporally-Ordered Routing Algorithm (TORA). Several performance studies of ad hoc networks have shown that on-demand protocols incur lower routing overheads compared to their proactive counterparts as Destination-Sequenced Distance-Vector Routing protocol (DSDV).

However, they are not without performance problems. High route discovery latency together with frequent route discovery attempts in dynamic networks can affect the performance adversely. Also, frequent route breaks cause the intermediate nodes to drop packets because no alternate path to the destination is available. This reduces the overall throughput and the packet delivery ratio. Moreover, in high mobility scenarios, the average end-to-end delay can be significantly high due to frequent route discoveries.

Multipath on-demand protocols, like Adaptive Ondemand Multipath Distance Vector (AOMDV) routing, try to alleviate these problems by computing and caching multiple paths obtained during a single route discovery process. The performance of these protocols tends to increase with node density; at higher node densities, a greater number of alternate paths are available. In such protocols a link failure in the primary path, through which data transmission is actually taking place, causes the source to switch to an alternate path instead of initiating another route discovery. A new route discovery occurs only when all precomputed paths break. This approach can result in reduced delay since packets do not need to be buffered at the source when an alternate path is available. But one problem with these Multipath protocols like is that although during the route discovery process multiple paths are discovered, only the best path based on some metric is chosen and is used for data transmission. The other paths are used only when the primary path fails. But in most cases, due to no maintenance of these paths, the alternate paths are rendered invalid by the time they are required. Using such stale or invalid paths result in more dropped packets as each of the alternate routes is tried in succession.

Staying connected anywhere to a network is really the main objective of mobile technologies. Mobile Ad hoc NETwork (MANET) may provide a solution. With MANET, all nodes are routers and forward packets without any infrastructure. This kind of network is spontaneous, self-organized and self-maintained. In this context, routing the data is the big challenging task since many issues are covered: scalability, security, lifetime of network, wireless transmissions, increasing needs of applications.

Many routing protocols have been developed for ad hoc networks. They can be classified according to different criteria. The most important is by the type of route discovery. It enables to separate the routing protocols into two categories: proactive and reactive. In reactive protocols, e.g. Dynamic Source Routing (DSR) and Ad hoc Ondemand Distance Vector routing (AODV), the routing request is sent on-demand: if a node wants to communicate with another, then it broadcasts a route request and expects a response from the destination. Conversely, proactive protocols update their routing information continuously in order to have a permanent overview of the network topology (e.g. OLSR).

Another criterion for ad hoc routing protocol classification is the number of routes computed between source and destination: multipath and single path routing protocols. Unlike its wired counterpart, the ad hoc network is more prone to both link and node failures due to expired node power or node mobility. As a result, the route used for routing might break down for different reasons. To increase the routing resilience against link or/and node failures, one solution is to route a message via multiple disjoint paths simultaneously. Thus, the destination node is still able to receive the message even if there is only one surviving routing path. This approach attempts to mainly address the problems of the scalability, mobility and link instability of the network. The multipath approach takes advantage from the large and dense networks.

Mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs) have received tremendous attention in the past few years. A MANET is a collection of nodes that can move freely and communicate with each other using the wireless devices. For the nodes that are not within the direct communication range, other nodes in the network work collectively to relay packets for them. A MANET is characterized by its dynamic topological changes, limited communication bandwidth, and limited battery power of nodes. The network topology of a MANET can change frequently and dramatically. One reason is that nodes in a MANET are capable of moving collectively or randomly. When one node moves out of/in to the transmission range of another node, the link between the two becomes down/up.

Another reason that causes the topological changes is the unstable wireless links, which might become up and down due to the signal fading (obstacles between the two end nodes), interference from other signals, or the changing of transmission power levels. Most of the mobile nodes are battery powered, when the nodes run out of the battery power, the node failure will also cause the topological changes.

Although a close relative to MANETs, a WSN differs from an ad hoc network in many aspects. The number of nodes in a WSN is usually much larger than that in an ad hoc network. Sensor nodes are more resource constrained in terms of power, computational capabilities, and memory. Sensor nodes are typically randomly and densely deployed (e.g., by aerial scattering) within the target sensing area. The post-deployment topology is not predetermined. Although in many cases the nodes are static, the topology might change frequently because the sensor nodes and the wireless channels are prone to failure.

Multipath routing has drawn extensive attention in MANETs and WSNs recently. The dense deployment of nodes in MANETs/WSNs makes the multipath routing a nature and promising technique to cope with the frequent topological changes and consequently unreliable communication services. Research efforts have also been made using multipath routing to improve the robustness of data delivery, to balance the traffic load and balance the power consumption among nodes, to reduce the end-to-end delay and the frequency of route discoveries, and to improve the network security, etc. Two primary technical focuses in this area are, (a) the multipath routing protocols that are able to find multiple paths with the desired properties, and (b) the policies on the usage of the multiple paths and the traffic distribution among the multiple paths, which very often involve coding schemes that help to split the traffic.

BACKGROUND SURVEY

Destination-Sequenced Distance-Vector (DSDV): The Destination-Sequenced Distance-Vector (DSDV) Routing Algorithm is based on the idea of the classical Bellman-Ford Routing Algorithm with certain improvements. Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their immediate neighbors. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven.

The routing table updates can be sent in two ways: - a "full dump" or an incremental update. A full dump sends the full routing table to the neighbors and could span many packets whereas in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. If there is space in the incremental update packet then those entries may be included whose sequence number has changed. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. In a fast-changing network, incremental packets can grow big so full dumps will be more frequent. Each route update packet, in addition to the routing table information, also contains a unique sequence number assigned by the transmitter. The route labeled with the highest (i.e. most recent) sequence number is used. If two routes have the same sequence number then the route with the best metric (i.e. shortest route) is used. Based on the past history, the stations estimate the settling time of routes. The stations delay the transmission of a routing update by settling time so as to eliminate those updates that would occur if a better route were found very soon and.

Optimized Link State Routing Protocol (OLSR): Classic link-state algorithms declare all links with neighboring nodes and flood the entire network with routing messages. Optimized link-state routing compacts control packet size by declaring only multipoint relay selectors, a subset of neighboring links. To further reduce traffic, OLSR uses only the selected nodes, called multipoint relays (MPRs), to flood the network with routing messages. Each node selects a set of neighboring nodes as MPRs, and these nodes rebroadcast packets received from the originating node. Thus, unlike ordinary broadcast, not every node forwards routing messages. Each node maintains a table of MPR selectors and rebroadcasts every message coming from those selectors. In this way, the network distributes only partial link-state information, which OLSR can use to calculate an optimal route in terms of number of hops. Each node periodically broadcasts hello messages containing information about its neighbors and a link status. Nodes select the minimal subset of MPRs among one-hop neighbors to cover all nodes two hops away. Thus, every node in the two hop neighborhood must have a symmetric link to a given node's MPR set. Because OLSR significantly reduces the number of broadcast retransmissions, this algorithm is most effective in networks with dense node distribution and frequent communication and.

QoS Routing: "Quality of Service—the collective effect of service performance which determines the degree of satisfaction of a user of the service". The provisioning of QoS based network services is in general terms an extremely complex problem, and a significant part of this complexity lies in the routing layer. The goals of QoS routing are twofold: selecting paths that can satisfy given QoS requirements of arriving communication requests, and achieving global efficiency in resource utilization. The following issues were addressed in QOS routing and.

Dynamically Varying Network Topology: Since the nodes in an ad hoc wireless network do not have any restriction on mobility, the network topology changes dynamically. Hence the admitted QoS sessions may suffer due to frequent path breaks, thereby requiring such sessions to be re-established over new paths.

Imprecise State Information: The state information is inherently imprecise due to dynamic changes in network topology and channel characteristics. Hence routing decisions may not be accurate, resulting in some of the real-time packets missing their deadlines.

Lack of Central Coordination: Unlike wireless LANs and cellular networks, AWNs do not have central controllers to coordinate the activity of nodes. This further complicates QoS provisioning in AWNs.

Error Prone Shared Radio Channel: During propagation through the wireless medium the radio waves suffer from several impairments such as attenuation, multi-path propagation, and interference (from other wireless devices operating in the vicinity).

Hidden Terminal Problem: This problem occurs when packets originating from two or more sender nodes, which are not within the direct transmission range of each other, collide at a common receiver node.

Limited Resource Availability: Resources such as bandwidth, battery life, storage space, and processing capability are limited in AWNs. Insecure medium: Due to the broadcast nature of the wireless medium, communication through a wireless channel is highly insecure and.

Need for Multipath Routing: In case of the route failure, this single-path routing protocol initiates again another route discovery which put a massive load on the network. Single route to destination node increases the probability of a malicious node existence in discovered path. Single Path protocols learn routes and select a single best route to each destination. These protocols are incapable of load balancing traffic. Multi-path protocols learn routes and can select more than one path to a destination. These protocols are better for performing load balancing. Single-path inter-networks are not fault tolerant. Multipath internetworks are fault tolerant when dynamic routing is used. Also single path routing is less efficient in bandwidth aggregation and reduced delay when compared to mutipath routing.

Multipath routing allows the establishment of multiple paths between a pair of source and destination node. It is typically proposed in order to increase the reliability of data transmission or to provide load balancing and has received more and more attentions.

In recent presented a new approach based on a mobile routing backbone for supporting Quality of Service (QoS) in MANETs. In real-life MANETs, nodes will possess different communication capabilities and processing characteristics. Hence, they aimed to identify those nodes whose capabilities and characteristics will enable them to take part in the mobile routing backbone and efficiently participate in the routing process. Moreover, the route discovery mechanism we developed for the mobile routing backbone dynamically distributes traffic within the network according to current network traffic levels and nodes' processing loads. Simulation results showed that their solution improved network throughput and packet delivery ratio by directing traffic through lowly congested regions of the network that are rich in resources. Moreover, their protocol incurs lower communication overheads than AODV (ad hoc on-demand distance vector routing protocol) when searching for routes in the network . But this scheme is operated on single path. If the multipath routing is used, it will improve the reliability and throughput and favors load balancing. So, in this paper, we tend to extend this scheme over multipath routing protocol and.

RELATED WORK

As proposed by , Ad Hoc On-Demand Multipath Distance Vector Routing (AOMDV) protocol discovers multiple routes during route discovery. AOMDV creates multiple loop-free link disjoint paths. However one limitation is that all the routes are not maintained simultaneously and as a result they timeout, thereby nullifying the advantage of multiple paths. In Sambasivam et al propose to use periodic update packets unicast along each path which are used to measure the signal strength of each hop along the alternate paths and at any point, only the path with the strongest signal strength is used for data transmission.

In , Roy et al propose a New Layer that is capable of gathering Neighbor Stability information which can be used to modify the routing algorithms like AODV so as to refrain them from accepting spurious route update messages (like the route updates broadcast by nodes passing by) to avoid unstable neighbors to be identified as the forwarding node. For this purpose, a Protocol Specific Beacon has been used. In this paper, we propose to augment this beacon so that the nodes in the network can piggy-back their status information like the current fractional usage of its available bandwidth, available battery power etc.

In addition to the neighbor stability information as in , a neighboring node's signal strength is also measured as a metric for node stability, as proposed in . Using these additional pieces of information, the routing entity in the Network Layer can decide to select the optimal paths, from the set of available multiple paths, through which the packet has to be forwarded. Stated otherwise, the routing entity does not statically select a route to be optimal at the time of route discovery.

Instead it dynamically determines the optimal route every time a data packet has to be forwarded. This dynamic selection of forwarding path has a twofold advantage in addition to those provided by the traditional Multipath routing algorithms as: first, it allows a proper load distribution throughout the network by using the additional paths to carry some traffic provided it is feasible, and second, as in most cases, the alternate routes are being used for data transfer and hence are updates thereby preventing the timing out of these routes.

OLSR-based QoS Routing: In previous method integrated QoS features into the Optimized Link State Routing (OLSR) protocol to find a path with larger bandwidth. This approach does not modify the routing scheme of OLSR, but it chooses the different criteria to set the multipoint relays (MPR) set so as to find a larger bandwidth path.

OLSR is an optimization of the classical link state flooding algorithm. In OLSR, a set of nodes is chosen to form an MPR set such that broadcast packets are forwarded only among the MPR set. In this way, overhead is reduced significantly compared with classical flooding where every node needs to forward broadcast packets. Therefore, how to choose the MPR set is the key point of the OLSR algorithm. In the OLSR IETF draft, the one-hop neighbors that cover more two-hop neighbors are elected to the MPR set, in order to minimize the number of MPRs. Using this scheme for MPR election, it is quite possible that the low available bandwidth nodes will be chosen for the MPR set, which causes the routes to go through nodes with low available bandwidth.

Ad Hoc QoS on-demand routing: It is a QoS-aware routing protocol with the following features: (1) available bandwidth estimation and end-to-end delay measurement, (2) bandwidth reservation, and (3) adaptive route recovery.

This routing is an on-demand QoS-aware routing protocol. When a route is needed, the source host initiates a route request, in which the bandwidth and delay requirements are specified. The intermediate hosts check their available bandwidth and perform bandwidth admission hop-by-hop. If the bandwidth at the intermediate host is sufficient to support the request, an entry will be created in the routing table with an expiration time. If the reply packet does not arrive in the allotted time, the entry will be deleted. Using this approach, a reply packet whose delay exceeds the requirement will be deleted immediately in order to reduce overhead.

PERFORMANCE BENEFITS FROM MULTIPATH ROUTING

Multipath routing has been studied for various network control and management purposes in various types of networks. In this paper, we outline some of the applications of multipath routing that improve the performance of an ad hoc network and a sensor network.

Reliability - By "reliability" we mean the probability that a message generated at one place in the network can actually be routed to the intended destination. Reliability is a big challenge in MANETs/WSNs because packets transmitted are subject to lost due to frequent topological changes, severe media access conflicts, and various kinds of interferences that affect the wireless transceivers to correctly decode the wireless signals.

Multipath routing in a MANET was originally developed as a means to provide route failure protection. For example, the Dynamic Source Routing (DSR) protocol is capable of caching multiple routes to a certain destination. When the primary path fails, an alternate one will be used to salvage the packet. The Temporally Ordered Routing Algorithm (TORA) also provides multiple paths by maintaining a destination-oriented directed acyclic graph (DAG) from the source node. Multipath extensions of some protocols that originally depend on the single path routing have also be proposed, such as the AODV-BR, Alternative Path Routing (APR), and Split Multipath Routing (SMR), etc., which improve the single path routing protocols by providing multiple alternate routes. In these cases, the multiple paths are not used simultaneously. The traffic takes one of the multiple paths at a time. Other paths are kept as backup in case the used one is broken. When all known paths are broken, a new multipath discovery procedure is initiated. Alternate path routing has also been adopted at link layer - when multiple next hops are available, the packet is routed through the one that exhibits best channel condition.

Load/Energy Consumption Balancing - Nodes in a MANET or WSN are typically powered by batteries which have limited energy reservoir. In some application scenarios, replenishment of power supplies might not be possible. The lifetime of the nodes show strong dependence on the lifetime of the batteries. In the multihop MANET/WSN, nodes depend on each other to relay packets. The loss of some nodes may cause significant topological changes, undermine the network operation, and affect the lifetime of the network.

Energy efficient routing has been the subject of intensive study in recent years. One goal of the energy aware routing (EAR) protocols is to select the best path such that the total energy consumed by the network is minimized. A serious drawback of the minimum energy routing is that nodes will have wide difference in energy consumption. Nodes on the minimum energy paths will quickly drain out while the other nodes remain intact. This will result in the early death of some nodes. Another objective of the EAR is to maximize the system lifetime, which is defined as the duration when the system starts to work till any node runs out of energy, or till a certain number of nodes run out of energy, or till the network is partitioned, etc. For this purpose, multipath routing has been shown effective since it distributes the traffic load among more nodes and in proportion to their residual energies. When the energy consumption among nodes are more balanced, the mean time to node failure is prolonged, and the system lifetime is prolonged too.

Routing Overhead - Another benefit of multipath routing is the reduction of the routing overhead. Existing ad hoc routing protocols can be generally categorized into three classes: table-driven (or proactive, such as DSDV and WRP), on-demand (or reactive, such as DSR and AODV), and hybrid (the combination of the two, such as ZRP).

Most of the performance studies indicate that on-demand routing protocols outper form table-driven protocols. The major advantage of the on-demand routing comes from the reduction of the routing overhead, as high routing overhead usually has a significant performance impact in low bandwidth wireless networks.

An on-demand routing protocol attempts to discover a route to a destination “on demand” when it is presented a packet for forwarding to that destination but it does not already know a path. It utilizes a route discovery process to find the path(s).

Discovered routes are maintained by a route maintenance procedure until either the destination becomes inaccessible along every path from the source or until the route is no longer desired. The route discovery is a costly operation and it usually involves a network-wide flooding of route request packets since the node has no idea where the destination is. Typically three types of routing messages are used - Route Request (RREQ) and Route Reply (RREP) messages are used in the route discovery process to search for a route; Route Error (RERR) message is used to report the breakage of an intermediate link on a route back to the source. On-demand multipath protocols find multiple paths between a source and a destination in a single route discovery. A new route discovery is needed only when all the found paths fail. In, the authors proved that the use of multiple paths in DSR can keep correct end-to-end connection for a longer time than a single path. Therefore, by keeping multiple paths to a destination, the frequency of the costly route discovery is much lower. Moreover, in a single path routing case, when a node fails to transmit a packet to its next hop, a route error message will be sent back to the source indicating the breakage of the path. With multiple alternate paths available, nodes can actively salvage the packet by sending it to an alternate path, a route error will occur only when all the available paths fail. The occurrence of route error is therefore reduced too. Although the search for multiple paths may need more route request messages and route reply messages in a single route discovery process, the number of overall routing messages is actually reduced. Similar results have been reported in.

Quality of Service (QoS) - An important objective of multipath routing is to provide quality of service, more specifically, to reduce the end-to-end delay, to avoid or alleviate the congestion, and to improve the end-to-end throughput, etc. It has been shown that multipath routing helps significantly in providing QoS by reducing the end-to-end delay for packet delivery. The reduction in the end-to-end delay is not that intuitive and is attributed to multiple factors. Notice that the end-to-end delay is the latency between a packet sent at the source and received at the destination. Besides the ordinary transmission delay, propagation delay, and queuing delay, which widely exist in all IP networks, there are two types of latency caused particularly by ad hoc on-demand routing protocols. One is the latency the protocol takes to discover a route to a destination when there is no known route to that destination. This type of latency is due to the on-demand behavior of the routing protocol and exists in all such protocols. Multipath routing effectively reduces the frequency of route discovery therefore the latency caused by this reason is reduced. The other one is the latency for a sender to “recover” when a route being used breaks. The latency resulting from broken routes could be very large because the amount of latency is the addition of the following three parts - the time for a packet to travel along the route to the node immediately before the broken link, the time for that node to detect the broken link, and the time for a route error message to travel from that node back to the source node. Among them, the time to detect a broken link could be very large because the failure of the link can only be determined after having made a certain number of attempts to transmit the packet over the broken link but failed to receive a passive or explicit acknowledgement of success. This latency caused by route errors is a significant component in the overall packet latency. Multipath routing avoids or reduces the occurrence of route errors therefore the packet latency is further reduced. Some other factors contribute to the reduction in the end-to-end delay as well, such as the routing around the congested area, etc.

Security - A few efforts have been made to improve the network security by using multipath routing. While used for security purpose, multipath routing is often combined with secret sharing cryptography. A (T;N) threshold secret sharing scheme has the nice property that it divides a secret into N pieces, called shares or shadows; One can derive nothing from any less than T shares, while with an efficient algorithm, the original secret can be reconstructed from any T shares. Therefore, schemes combining multipath routing and secret sharing techniques typically involve the splitting of a secret by secret sharing schemes and the delivery of the shares by multipath routing. By this means, the trust is distributed to multiple nodes/paths in the network and the system is made more resilient to a collusive attack by up to a certain number of compromised nodes.

PROPOSED TECHNIQUES

A DSDV protocol is viewed to associate with so many problems as mentioned above and is seen to perform low especially with high node density and mobility. Therefore it is not reliable to incorporate QoS for DSDV. This is because DSDV does not guarantee assurance of enhancing the band width management metrics, packet delivery fraction and Goodput. Moreover the unpredictable nature of Ad-Hoc networks and the requirement of quick reaction to QoS routing demands make the idea of a ―link-optimization routing‖ protocol more suitable. When a request arrives, the control layer can easily check if the pre-computed optimal route can satisfy such a request. Thus, wasting network resources when attempting to discover feasible routes can be avoided. Based on this consideration, unlike DSDV QoS routing protocols, we are studying ―link-optimization routing‖. The task is to re-compute a route, which is the best route, based on the Secure Qos constraint among all the possible routes. The approach followed in this paper work is to integrate the Secure Qos feature into OLSR, which is a pro-active routing protocol in a way optimal and more effective than other approaches. In simulations, we will first show that the traditional best effort OLSR outsmart the DSDV in band width management metrics, packet delivery fraction and goodput. We then incorporate Secure Qos into the promising OLSR, see the simulation and justify the results.

Design of Proposed Algorithm: The idea behind this algorithm for New Secure Qos OLSR is to select the highest bandwidth neighbors with optimal number of MPR: (N and N2 denotes all the 1 hop and 2 hop neighbor of the source node respectively)

a. Start with an empty MPR set

b. Select as MPRs nodes in neighbors N which provide the only path to some nodes in 2-hop neighbors N2

c. While there exist nodes in N2 which are not covered

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a) Select as MPR a node that has the highest bandwidth link connected with the current node and minimum possible set of MPR.

b) Mark the neighbors of the newly selected MPR as covered in the 2-hop neighbor set of the current node

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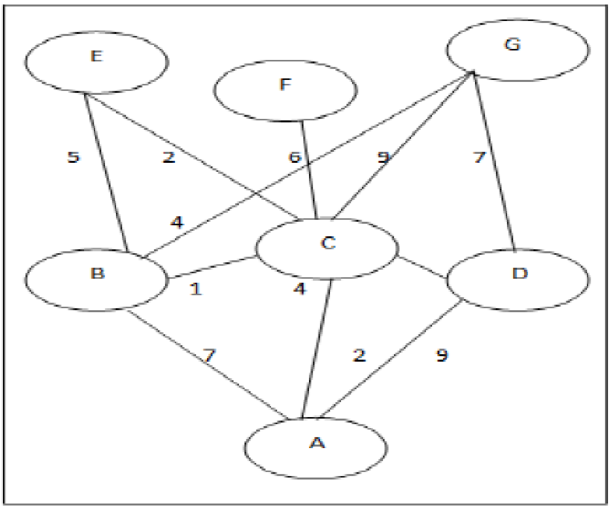

Figure 1: New MPR Selection.

Among node A's neighbors, B, C, and D have a connection to its 2-hop neighbors. Among them, even if link AD has the largest bandwidth we choose node B. This will reduce the number of MPR and maintain selection of optimal wider link band width. So B is first selected as A.s MPR, and the 2-hop Neighbor E & G are covered. Similarly, C is selected as MPR and F is covered, so all 2-hop neighbors are covered and the algorithm terminates.

Available link band width calculation: Secure Qos OLSR uses the media idle time to reflect the available bandwidth over a link. If the node is sending packets, its transmitter becomes busy. If there are other nodes beginning transmission within the interference range of the current node, its receiver senses the busy media and sends a media busy signal. As the MAC Layer already defines functionalities to capture changes of the media, the available link bandwidth is computed: Each node is randomly assigned an idle time ranging from 0 to 1. The available link bandwidth between two nodes is equal to the minimum of their idle time multiplied by the maximum bandwidth. Here, we consider that in the Ad-Hoc network, each link has the same maximum bandwidth, 2 Mbps. For example, if node A's idle time is 0.5 and node B's idle time is 0.3, then the available bandwidth over link AB is: 0.3 *2Mbps = 600 kbps. These randomly generated idle times reflect the traffic condition in the network snapshot because the consumed bandwidth over each link reflects the traffic flows over that link.

Performance Evaluation Metrics: The metrics have been chosen in order to evaluate the routing protocols for Secure Qos in terms of wider link band width measured as Goodput, low percentage of packet loss and low routing load. The main attention was given to evaluate the routing layer performances. This is because Goodput alone does not indicate whether a protocol A is better than a protocol B. How it achieves higher Goodput when combined with scalability is a good measure of a better performance. The following three metrics capture the most basic overall performance of Routing protocols studied in this paper work: -

Good put: Good put is defined as the amount of useful data, or payload that can be processed by, passed through, or otherwise put through a system when operating at maximum capacity and received at the correct destination address. Goodput can be thought of as throughput seen by the receiver.

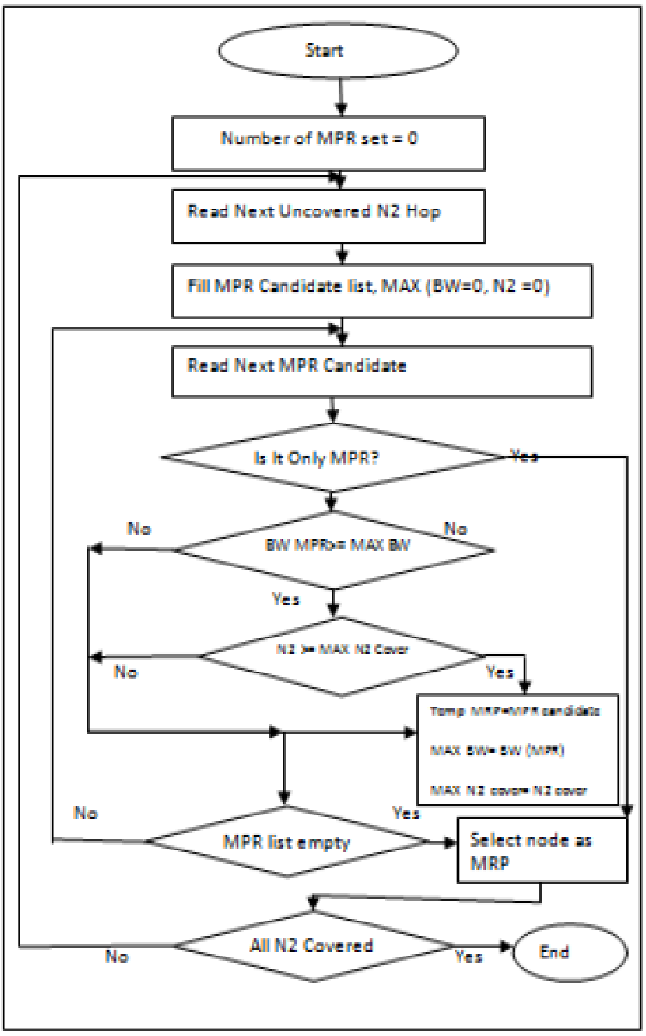

Figure 2: Flow Chart Secure Qos OLSR.

$$\text{Goodput} = \frac{(\text{max no of pkts recvd by the Rx in sequence}) * \text{packet size}}{\text{Measurement interval}}$$

Packet Delivery Fraction: The packet delivery ratio in this simulation is defined as the ratio between the number of packets sent by constant bit rate sources and the number of packets received by the CBR sink at destination.

$$\text{Packet Delivery Fraction (PDF)} = \frac{\text{CBR packets received by CBR sinks}}{\text{CBR packets sent by CBR sources}}$$

Normalized Routing Load (NRL): Routing overhead is the number of routing packets transmitted per data packet delivered at the destination. Each hop-wise transmission of a routing packet is counted as one transmission.

$$\text{Normalized Routing load} = \frac{\text{Number of Routing Packets sent}}{\text{Number of Data Packets Received}}$$

Average End-to-End Delay of data packets (AED): The end-to-end delay is defined as time between the point in time the source want to send a packet and the moment the packet reaches it destination. It includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times.

$$\text{Average end to end Delay} = \sum \frac{\text{T (destination receives packet)} - \text{T (source wants to sent packet)}}{\text{Number of Packets}}$$

CONCLUSION

Multipath routing has been a promising technique in MANETs and WSNs. It has been shown through both theoretical analysis and simulation results that multipath routing provides many performance benefits, including the improved fault tolerance, security, and reliability, improved routing efficiency and reduced routing overhead, more balanced traffic load and energy consumption, reduced end-to-end latency and aggregated network bandwidth, etc. Significant research efforts have been made and are continuously being made in developing multipath routing protocols and multipath packet forwarding techniques in order to achieve the abovementioned performance gains effectively and efficiently.

In this paper we propose a possible optimization to the AOMDV routing protocol in order that the alternate routes, discovered during the route discovery process, are maintained and the load can be effectively distributed so that no node is overburdened i.e. it is made to carry most of the traffic from a particular node. This is true only when an alternate route exists. Data transmission through these alternate routes helps maintain them and prevent them from timing out. We have proposed an approach for selecting the best possible next hop from a list of neighbors. In future we aim to find out an expression that would select the optimal next hop based on the various values obtained from the NIT. We also aim to evaluate how this optimized algorithm performs based on some metrics like Packet Delivery Ratio, Average End-to-End Delay and Control Overhead.

In this paper work, the principles of mobile ad hoc networks focusing on how to incorporate secure Qos will discussed. The importance of band width management Secure Qos metrics in growing node density and mobility is significant in mobile Ad-Hoc network. Two of the most commonly use Proactive routing protocols DSDV and OLSR protocols are studied. In order to decide which of the two proactive protocols Secure Qos will suit more, several literature reviews have been reviewed and comparative analysis. Both the reviewed literature and the results of the comparative analysis have proved OLSR to be a promising candidate to best perform in Secure Qos incorporation. This is because the band width management metrics have shown promising figures in OLSR than in DSDV and it is this set of Metrics that the study work is working up on. We will discuss in detail our idea of adding Secure Qos into the OLSR protocol. Our algorithm allows OLSR to find the maximum bandwidth path with optimal number of MPR.

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