QUALITY OF SERVICE FOR WIRELESS MOBILE AD-HOC NETWORKS

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Abstract: **The quality of service in MANET has been improved with the incorporation of a new Adhoc QoS Multicasting (AQM) algorithm. Also, a cross layer frame work is proposed and evaluated for delivering the data effectively. The distributed admission control at every intermediate node is used for avoiding the interaction between nodes, also admission control prevents new destinations to join multicast group if there are no QoS requirements. An ad hoc QoS multicasting (AQM) is compared to a non-QoS scheme with regard to session efficiency. By applying QoS restrictions to the ad hoc network, better satisfaction has been achieved in grades of AQM. Also, remarkable improvement in the multicasting efficiency for sessions is observed.**

Lastly, with regard to reliable services a Multicast zone routing protocol (MZRP) for mobile ad-hoc networks has been proposed and implemented. It is observed that the routing protocol provides the on-demand procedures to establish dynamically mesh-based multicast routing zones along the path from multicast source node to the multicast receivers. It is also observed that the multicast overhead is considerably reduced, and good scalability is achieved with incorporation of control packet flooding inside the multicast zones. Reliable multicast becomes a very challenging problem due to high packet loss rate pertaining to MANETs. The packet losses are caused by error-prone wireless media and node mobility. To reduce packet loss rate a ReAct transport layer protocol has been implemented on top of the MZRP network layer protocol in order to provide reliable services to the multicast receivers. The results of both UDP and ReAct have been compared. From these results, it is noticed that the performance of ReAct is better than the UDP. Also, from the performance studies, it is clearly observed that the ReAct's local recovery mechanism, manages to prevent the source from reducing its rate unnecessarily, thus improving throughput as compared to ReAct's throughput. New performance evaluation metric called average key update energy is introduced for the improvement of performance of the energy-efficient key distribution trees for securing multicast communications in wireless ad hoc networks.

INTRODUCTION:

In mobile ad hoc networks (MANETs), all communications are done over wireless media, typically by radio packet through the air, without the help of wired base stations. Direct communication is allowed only between adjacent nodes. So, distant nodes communicate over multiple hops, and nodes must cooperate with each other to provide routing.

The QOS routing in MANETs is difficult because the network topology will change dynamically, the available state information for routing changes dynamically, nodes may join, leave, and rejoin an ad hoc network at any time and any location. Additional challenges in ad hoc networks are attributed to mobility of intermediate nodes, absence of routing infrastructure, low bandwidth and computational capacity of the nodes. Another challenge with supporting QOS for real-time applications is associated with the design of the medium access control (MAC) protocol. The dynamic nature of wireless ad hoc networks makes it difficult to dynamically assign a central controller to maintain connection state and reservations. Because of this, best effort distributed MAC controller is widely used in existing wireless ad hoc networks.

There are many requirements to provide QOS in MANETs, first, find a route through the network that is capable of supporting a requested level of QOS. Second, ensure that when networks topology changes, new routes that can support existing QOS are available or can be quickly found. Third, respond to changes in available resources, either as the result of a route change or as the result of change link's characteristics with a given route. Providing support for real-time data transmission is an important yet challenging goal for MANETs. Much research has been done in each network layer to support real-time data transmission. Various routing protocols have been proposed either to provide admission control or to find a path with large bandwidth to support a given request.

QOS in MANETS is highly dependent upon routing and medium access control; also there is a strong coupling between routing and MAC layer to improve QOS in MANETs. Delivering end-to-end service quality in MANETs is intrinsically linked to the performance of the routing protocol because new routes or alternative routes between source and destination pairs need to be periodically computed during ongoing session. Protocol layering is an important abstraction that reduces complexity for designing network but it is not well suited to wireless networks because the nature of the wireless medium makes it difficult to decouple the layers. Without interaction between protocol layers, meeting the end-to-end performance requirements of demanding applications will be very difficult. Stringent performance requirements to provide QOS multicast application over MANETs can only be met thorough a cross-layer design. Information exchanged between layers ensures robustness. For example, routing protocols can avoid building routes that cannot meet QOS requirements depending on information that come from MAC layer [10, 11].

Multicast routing is a promising technique, that packets are only multiplexed when it is necessary to reach two or more receivers on disjoint paths. Due to the increasing popularity of multimedia applications and potential commercial usages of MANETs, it is a logical step to support QOS in the multicasting. There are many applications, which naturally require QOS support in the multicast scenario. In a video/audio conference, the chairmen with other attendees make up a multicast group. Yet, many multimedia applications are characterized by a multicast communication pattern. Several protocols have been developed to perform ad hoc multicast routing, i.e. CAMP, ODMRP, M-AODV, and FGMP. However, these multicast protocols did not address the QOS aspect of ad hoc communication. There are several studies for unicast routing protocols with QOS in MANETs in literature, but QOS support for a multicast protocol should be differently designed from the unicast QOS. For a unicast QOS, the main issue is related to the resource reservation between a source and destination. On the other hand, a multicast QOS should provide QOS paths to all destinations, not only between the source and destination; as a result, QOS multicast should cope with large number of receivers and be able to utilize them. Recently, addresses QOS multicast routing, this protocol uses a lantern-tree as a topology for multicast group and CDMA/TDMA model at MAC layer; lantern-tree takes long time at startup to find all paths and to share time slots between neighbors. It splits flow in to multiple paths which add more complexity when more than one flow are admitted, nodes need to store and process more information about sub flows, multiple paths built and released without sending through them. In addition, CDMA/TDMA is difficult to be implemented in a real network.

Rationale:

The SLA mentions that the Quality of Service (QoS) in the Ad-Hoc network routing primarily depends on making use of a minimum delay guarantees. However, it is not an easy task to meet the demands of the

Supported services in an Ad-Hoc network:

There are many reasons that these demands cannot be met. The first reason is due to the changes in the physical medium leading to the change in the topology of the ad-hoc network.

This results in to the ups and downs in the link properties like error rate and bandwidth. The second reason is the stability factor. It proves to be extremely challenging to achieve stability in this dynamic network. And the last reason is the uncontrollable traffic that is generated by the interference, which cannot be resolved by the present service as it has no control.

It is common to see failures in packet delivery and delays in ad-hoc networks. This is caused due to the interference from different nodes in a randomly varying ad-hoc network. This interference could be resolved by increasing the back off delay on each node in the existing method so that a better packet transmission could be provided. The back off delay gets exponentially increased. However, in a wireless ad-hoc network, the exponential back off may not be suitable because the nodes in the inner network experience more collisions to that of the outer ones. Moreover, computing bandwidth for a given flow request in an ad-hoc network is difficult due to interference.[16]

REVIEW OF RELEVANT LITERATURE:

Background to subject of study:

As mentioned earlier, the system in this study implements the use of Aggressive back off Algorithm (ABA) and Shortest widest path (SWP) algorithm on every node of an ad-hoc network. At a given point of time where the neighbor nodes experience greater number of collisions between them, the traffic gets too uncontrollable. And the above mentioned algorithms are believed to be yielding best results. These algorithms provide a better efficiency by engulfing them with the existing ad-hoc networks in the following areas.

1. Battery field scenario
2. Disaster Relief
3. Military applications
4. Sensor Networks etc.

Examples and critique of current research in the field:

There is a brief description on 802.11 protocols standards in [1]. A two dimensional Markov model of exponential back off mechanism is described in [2]. The expressions are derived for finding the probability of packet transmission and saturation throughput [3] based on the impression that probability of collision between nodes doesn't depend on its own state. In their model Signal to Noise Ratio (SNR), carrier sense and non-saturated traffic are incorporated for both basic and RTS/CTS access mechanisms [3]. In specific, a complete analysis of Slotted Aloha MAC has evaluated its fairness and throughput. A rate control mechanism for random access networks has been proposed by authors of [5] .In this the system is said to be positive recurrent(stable) by rate control mechanism .In this author says when nodes are idle the *rate* at which the nodes attempt to transmit is increased and decreased after collision [5].

The problem of QoS routing in ad-hoc networks was addressed in [6] and [7], several solutions have been suggested to guarantee end-to-end quality for flows. One way to effectively provide QoS guarantees for a flow is to settle on a Time Division Multiplexing (TDM) scheme that chooses the exact time slots to be used by a flow along each link, this approach was proposed in [8]. The authors of [9] also proposed a way to achieve fair and maximum allocation of the shared wireless channel bandwidth. More recently, [10] and [11] have proposed other algorithms to determine the exact schedule of slots for a flow through the network. A similar bandwidth based approach is suggested in [12], which considers the interference between neighboring links, as also the interference between multiple hops on the same flow. The authors of [14] describes briefly about routing protocols. The Papers [15], [16], [17] gives detail description of different routing protocols.

Wireless Networks:

The world has been introduced to a number of networking devices in the last decade. There also have been many devices that make use of wireless connectivity. However such wireless devices were restricted to only some big cities. Added to that, those devices needed subscription to enjoy such services. Taking a look at that from the technology point of view, the quality of connection could rarely facilitate to the high-bandwidth applications. The market on the other hand would be boosting for wireless devices that could provide a fine quality of connection.

The first type is the network which has fixed and wired gateways so we call it as the infrastructure network. The bridges between these networks are called as the base station. The mobile phone working in this type of a network connects itself to the closest base station that is available in its range of communication. In the case of movement, when the mobile moves from the range of base station A into the range of base station B, a "handoff" is carried out and gets in to the range of the new base station B. In this way a mobile phone keeps connected to a network while moving from place to place. Such an application makes use of office wireless local area networks (WLAN).

The second type of wireless mobile network is the Ad-Hoc network. This network has no infrastructure on its mobile network. Infrastructure less networks has no fixed routers where in all the nodes have a capacity of movement and they can be arbitrary connected even in movement. These nodes also as well function as routers so the nodes could mutually discover and maintain routes [5].

A multi-hop wireless networks happens to be the only feasible means for communication and information access in an application environment like a battlefield communication or disaster recovery. This kind of network is called Mobile Ad hoc Network (MANET). A MANET could provide great means of comfort in communication in a place or an event like campus recreation, conferences, and electronic classrooms and so on. [8]

PILOT RESEARCH METHOD:

Hypothesis:

The aim of this study is to centralize the focus on the Quality of Service for ad-hoc networks. It is a difficult task to support the Quality of Service (QoS) in a Mobile Ad-hoc network because of the bandwidth constraints and the dynamic nature of a MANET. Taking a step forward and focusing on the middle of the network, a new algorithm called as Aggressive Back off Algorithm is introduced to the middle of the network. This is done to achieve fairness allocation of the channel to the nodes lying in the middle of the network. This implementation however needs the decreasing of back off delay of the nodes upon collision or failure in transmission of packets in decreasing order. The resulting nodes become more aggressive upon collision hence the name, Aggressive back off algorithm. [5]

Nowadays, the networks take one main thing into consideration: routings. In present ad-hoc networks, routing is mainly concerned with connectivity. These days, there are a handful of routing algorithms in MAC. For example, Source routing or table driven, proactive or on demand. These routing algorithms bind the network as a single hoop and the shortest path algorithms are useful in finding the shortest path between source and destination. The problem that lies with the shortest path routing algorithms is that the results are not up to mark. So they cannot be used for application with QoS requirements (like bandwidth guarantees). Taking this into account, this study makes use of Shortest Widest Path (SWP) algorithm to decide the optimal paths for routing in an ad-hoc network. [6]

RESEARCH METHOD:

ROUTINGS IN AD-HOC NETWORK

Challenges in routings:

In an ad-hoc network, each node functions as a router. Every such router is capable of finding and maintaining routes with the other nodes on the network. The main task that lies at the disposition of every such ad hoc network routing protocol is in establishing the best efficient possible route between two nodes so that the communication remains time efficient. Such establishment of route must happen with minimum overhead and bandwidth consumption. There is a hard challenge in designing a routing protocol for the ad hoc networks in determining a packet route. One side to this challenge is that a node needs to know at least the reach ability information to the neighboring nodes. And the other side to this challenge lies in the fact that an ad hoc network topology is not constant. The mobility results in frequent link breaks and all routes that use the link need to be repaired. Added more to this, we know that the number of network nodes can be high. As a result, the potential number of destinations is also high. This requires huge amount of data exchange that includes errors and so on. Therefore, the amount of update traffic can be quite high. [7]

But we have to remember that all updates in a wireless interconnected ad hoc network travel over the air and they are expensive in terms of resources. But the nodes are battery powered and routing needs to be energy efficient. No single given protocol could work well in given different environments owing to such constraints.

There are a number of protocols that are designed and used for ad hoc mobile networks. Such protocols must deal with the typical limitations of these networks, which include high power consumption, low bandwidth, and high error rates. Fig. 1 shows us a general classification of these routing protocols.

- Table-driven
- Source-initiated (demand-driven)

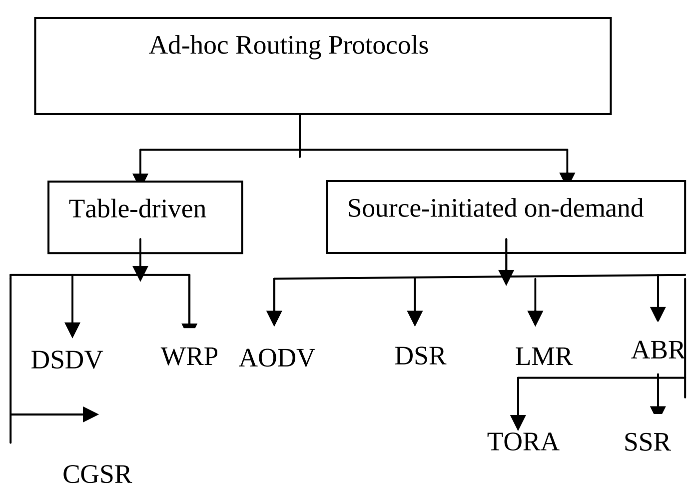

Figure1 shows the Categorization of Ad-hoc Routing Protocols

Even though this is designed for the same type of underlying network, the characteristics of each of these protocols is quite distinct. Based on the characteristics of the protocols, the following part gives a description and categorization of them in detail. [9]

Table-Driven Routing Protocols:

Table driven routing protocols make use of pro-active schemes without going for other options. These protocols primarily try an effort in maintaining consistency and up-to-date routing information between each node and all the other nodes on the network. For these protocols to be implemented, it requires that each node must maintain one or more tables to store routing information. Also if there are any changes in the network topology, it must be communicated by sending updates throughout the network so that there would be consistency in the view of the whole network. [10]

However, there are areas in which these protocols differ. They mainly differ in the number of necessary routing-tables and the methods by which changes in the network structure are broadcast. Some of the existing table-driven ad hoc routing protocols are as follows

Destination-Sequenced Distance –vector Routing:

Based on the classical Bellman-Ford routing mechanism, the Destination-Sequenced Distance-Vector Routing protocol (DSDV) is designed where every mobile node in the network maintains a routing table. And at every routing table, all of the possible destinations within the network and the number of hops to each destination are recorded.

A sequence number assigned by the destination node is marked on each entry. These sequence numbers enable the mobile nodes to distinguish stale routes from new ones. So they make it impossible for the formation of routing loops. Routing table updates are periodically transmitted throughout the network in order to maintain table consistency. The alleviation of a huge amount of network traffic generated by such updates , route updates can employ two possible types of packets. The first packet is known as a full dump. This type of packet carries all available routing information and can require multiple Network Protocol Data Units(NPDU). During the periods of occasional movement, these packets are transmitted infrequently. But smaller incremental packets are used to send only that information which has changed since the last full dump. Each of these broadcasts should fit into a standard-size NPDU. Resulting in the decrease of the amount of traffic that is potentially generated. An additional table is maintained in the mobile node where the data is stored and sent in the incremental routing information packets.[11]

Source-Initiated On-Demand Routing:

Another approach as opposed to the above discussed table-driven routing is source-initiated on-demand routing. The source-initiated on-demand routing initiates routes just when desired by the source node. When a node requires a route to a destination, within the network a route discovery process is initiated. This process is completed once a route is found or all possible route possibilities are examined. Once a route is initiated, it is 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.

Ad-Hoc On-Demand Distance Vector (AODV) Routing:

Adding upon what is discussed earlier, Ad Hoc On-Demand Distance Vector (AODV) routing protocol builds on the Destination- Sequenced Distance-Vector Routing protocol (DSDV). AODV is an improvement on DSDV as it minimizes the number of required broadcasts by initiating routes on a demand basis in comparison to maintaining a complete list of routes as it happens in the DSDV algorithm.

Upon initiation, when a source node wants to send a message to a destination node and when it does not yet have a valid route to that destination, it initiates a path discovery process to locate the other node. It broadcasts a Route Request (RREQ) packet to its neighboring nodes. And these requests are forwarded to the neighbors and so on, until either the destination or an intermediate node with a "fresh enough" route to the destination is located. Each and every node maintains its own sequence number and also a broadcast SEQUENCE NUMBER . The broadcast SEQUENCE NUMBER of a node is incremented for every RREQ the node initiates. Together with the node's IP address, the node uniquely sequence number entifies an RREQ. By making use of its self sequence number and the broadcast SEQUENCE NUMBER, the source node puts in RREQ the most recent sequence number it has to give for the destination. Intermediate nodes can reply to the RREQ only if they have a route to the destination whose corresponding destination sequence number is greater than or equal to that contained in the RREQ.

In this mechanism of forwarding the RREQ, the intermediate nodes record their route tables and the address of the neighbor from which they have received the first copy of the broadcast packet. So the intermediate nodes establish a reverse path. If additional copies of the same RREQ are later received, these packets are discarded. Once the RREQ reaches the destination or an intermediate node with a fresh enough route, the destination/intermediate node responds by unicasting a route reply (RREP) packet as shown in the figure 2, back to the neighbor from which it first received the RREQ.[12]

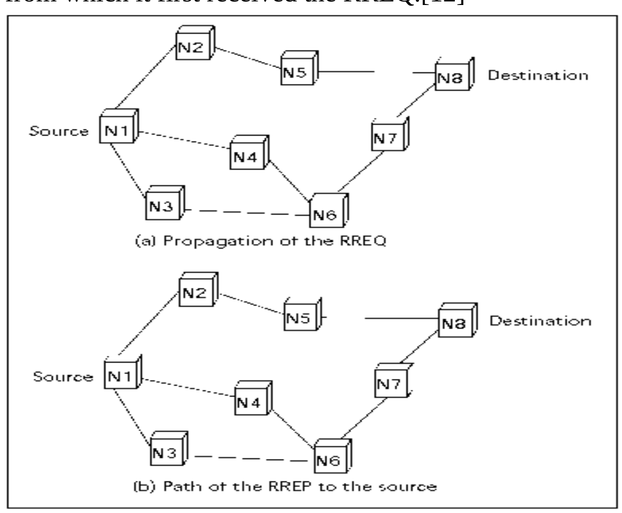

Figure2 AODV route discovery.

Dynamic Source Routing:

The Dynamic Source Routing (DSR) protocol is an on-demand routing protocol that is based on the same concept as of source routing. The mobile nodes need to maintain route caches that contain the source routes of which the mobile is informed of. Entries in the route cache are updated in continuation as new routes are discovered. The Dynamic Source Routing protocol has two major phases: route discovery and route maintenance. When a mobile node wants to send a packet to a destination node, it first consults its route cache to figure out if it already has a route to the destination. In the case where it has an unexpired route to the destination, it will use this route to send the packet. And in the case where the node does not have an unexpired route, it initiates route discovery by broadcasting a route request packet. This route request consists of the address of the destination, the source node's address and a unique identification number. Each node receiving the packet checks if it has a route to the destination. If it does not have a route to the destination, it adds its own address to the route record of the packet and on its outgoing links, it forwards this packet. In order to minimize the number of route requests propagated on the outgoing links of a node, a mobile only forwards the route request if the request has not yet been noticed by the mobile and if the mobile's address does not yet appear on the route record. A route reply is generated when the route request reaches either the destination itself, or an intermediate node which contains in its route cache an unexpired route to the destination. When packet reaches the destination or an intermediate node, it contains a route record yielding the sequence of hops taken. The formation of the route record as the route request propagates through the network is illustrated in Figure 3. When the route request reaches either the destination itself, or an intermediate node, which contains in its route cache an unexpired route to the destination, the generation of a route reply is initiated. It places the route record contained in the route request into the route reply, if the node generating the route reply is the destination. If the responding node is an intermediate node, then it will append its cached route to the route record and finally it generates the route reply. [15]

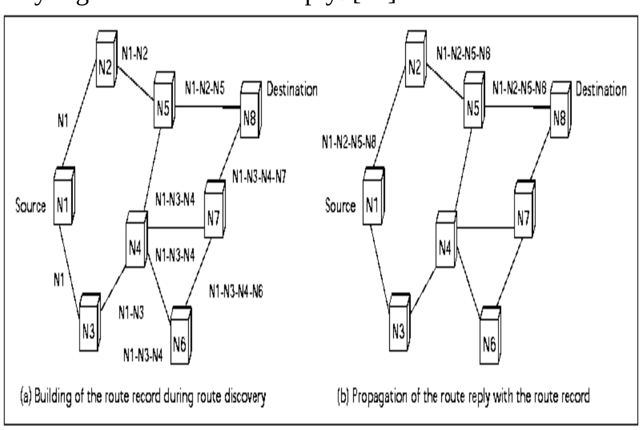

Figure 3. Creation of the route record in DSR.

Temporally Ordered Routing Algorithm:

The Temporally Ordered Routing Algorithm (TORA) is a highly adaptive loop-free distributed routing algorithm based on the concept of link reversal. TORA is supposed to be operative in a highly dynamic mobile networking environment. It is source-initiated and provides multiple routes given any desired pair of a source and destination nodes. The most important concept in design of TORA lies in the localization of control messages to a very small set of nodes near the occurrence of a topological change. In order to achieve this, nodes need to maintain routing information about adjacent or one-hop nodes. The protocol performs three basic functions:

- Route creation
- Route maintenance
- Route erasure

At the phases of route creation and maintenance, nodes use a "height" metric to establish a directed acyclic graph (DAG) rooted at the destination node. After that, links are assigned a direction which could be up stream or downstream, based on the relative height metric of neighboring nodes. The above method of establishing a DAG is same as the query/reply process proposed in Lightweight Mobile Routing (LMR). [14]

Associativity-Based Routing:

The Associatively Based Routing (ABR) protocol defines a new routing metric for ad hoc mobile networks. This protocol is free from loops, deadlock, and packet duplicates. This metric is called as the degree of association stability. In ABR, based on the degree of association stability of mobile nodes, a route is selected. At regular intervals of time, each node generates a beacon to signify its existence. And when the neighboring nodes receive, this beacon causes their associatively tables to be updated. The associatively tick of the current node with respect to the beaconing node is incremented when each and every beacon is received. Over time and space, the association stability is defined by connection stability of one node with respect to another node. A high degree of association stability may indicate a low state of node mobility, while a low degree may indicate a high state of node mobility. When the neighbors of a node or the node itself move out of proximity, associatively ticks are reset. To derive longer-lived routes for ad hoc mobile networks is one of the basic objectives of Associatively Based Routing. There are three phases of ABR viz.,

- Route discovery
- Route Reconstruction (RRC)
- Route deletion

The route discovery phase is attained by a Broadcast Query and wait-reply (BQ-REPLY) cycle. A node desiring a route broadcasts a BQ message in search of mobiles that have a route to the destination. All nodes receiving the query append their addresses and their associatively ticks with their neighbors along with QoS information to the query packet. A successor node erases its upstream node neighbors' associatively tick entries and then the successor node retains only the entry concerned with itself and its upstream node. In this manner, there exists the associativity tick of the nodes along the route to the destination in every resultant packet arriving at the destination.[18]

Initial Results:

1) To research the existing literature relating to Ad- Hoc network to identify appropriate methodologies for avoiding network congestion and improve quality of routing in randomly distributed wireless network.
2) To explore the issues related to the link requesting and back off mechanism for wireless ad-hoc network.
3) To develop algorithm for optimal routing in resource constraint ad-hoc network for high throughput and quality of service in ad-hoc network.
4) To develop a randomly distributed Ad-hoc network with all network topologies for performance evaluation.
5) To develop the DSR protocol for communication in ad-hoc network.
6) To test the developed enhancements for routing and back off due to collision under variable network parameters.
7) To evaluate the overall performance of the developed algorithms for different topologies, and at different level of interference for optimal route selection and back off mechanism.

OUTLINE OF PROPOSAL:

Aims of investigation:

The main aim of investigation is Quality of service in ad-hoc networks is quintessential and very crucial for various applications. We are going to focus on some of these applications that are of interest.

Disaster Relief:

Ad-hoc networks come into great help at the critical times of disaster relief. For example, if a region is hit by a natural disaster like earthquake or cyclone, it always dismantles and disassociates the existing communications infrastructure as shown in the figure. One of the biggest difficulties for the relief team is setting up the communication. The electronic methods of communications are the most dependent as there is no access of communication by roads during such time. At such a given situation, an ad-hoc network may be installed immediately in order to establish connectivity in that region. At the same time, it is important to provide QoS to support all the services desired on this network like voice calls, sending status information of resources etc. [20]

Military Applications:

The Military as well widely makes use of the ad-hoc QoS. For instance, a military tank during the time of battle. In a battlefield, there are many tanks that need to communicate among each others. It is highly impossible to decide the priority of the communications. The main tank is outside the range of communications and the images that are captured by the main tank need to be sent to the other tanks while other tanks are also involved at the same time in audio signal communication. Such an application scenario could be well supported and maintained between them by the ad-hoc networks.

Research objective:

The aim of this study is to centralize the focus on the Quality of Service for ad-hoc networks. It is a difficult task to support the Quality of Service (QoS) in a Mobile Ad-hoc network because of the bandwidth constraints and the dynamic nature of a MANET. Taking a step forward and focusing on the middle of the network, a new algorithm called as Aggressive Back off Algorithm is introduced to the middle of the network.

Methodologies:

Different types of methodologies are used in my research like observing, analyzing and searching for solution and selecting the best solution for current research and implementing the solution in the research.

Ethical considerations:

There are no ethical considerations in my research.

Limitations and Scope:

The first step in attaining QOS in the Ad-Hoc networks is implementing the ABA. Although simple implementation of ABA does not make it a complete MAC protocol. It acts as just a back off mechanism for channel allocation in distributed Ad-hoc networks. However, the main goal is to achieve fairness among nodes in order to get a desired throughput for specific parts in network. Taking this into consideration, we can say that there is so much still remaining to achieve in MAC protocol.

The use of shortest widest path algorithm is to compute the optimal path between two or more nodes. Interference in Ad-hoc network is not due to a single interferer but due to signal-to-noise ratio at the destination.

Personal development requirements:

A possible imagination of a future home makes uses of a wide variety of devices that are all connected to each other over the wireless channel. Especially, entertainment devices like home theater, music system and your personal computer need to communicate with each other that requires wireless communication. Ad-Hoc networks could best meet this home device communication demands.[19]

Resource Requirements:

In my research I mostly covered many topics under ad hoc networks and its quality services. More time is required to do research on ad hoc network and its quality services to get more information.

CONCLUSION:

The Random Back off Delay concepts is used by many Adhoc MAC protocols to avoid collisions and to share bandwidth among the nodes in the network. The basic rule in the back off algorithms is to become less aggressive after collision and try to capture the slot. But when this approach was used in the Ad-Hoc network, leads to unfairness towards nodes in the middle of the network.

From the all above observations it is concluded that on integration of ABA with SWP on existing Ad-Hoc networks the Quality of Service (QoS) could be improved resulting in fairness operation.

REFERENCES:

1. IEEE Standard for Wireless LAN Medium Access Control (MAC) and Physical layer (PHY) Specifications,
2. G. Bianchi, “Performance Analysis of the IEEE 802.11 Distributed Coordination Function,” IEEE Journal on Selected Areas in Communications, vol. 18, March 2000.
3. M. Ergen and P. Varaiya, “Throughput Analysis and Admission Control for IEEE 802.11a,”.
4. D. Bertsekas and R. Gallagher, “Data Networks (2nd Edition),” Prentice Hall

5. C. Yuan and P. Marbach, “Rate Control in Random Access Networks,” preprint.
6. E. M. Royer, C. Perkins, and S. R. Das, “Quality of Service for Ad-Hoc On-Demand Distance Vector Routing,” Internet Draft draft-ietf-manetaodv-00.txt.
7. S. Chen and K. Nahrstedt, “Distributed quality-of-service routing in adhoc networks,” IEEE Journal Selected Areas in Communication, vol. 17 no. 8, pp. 14881505.
8. C. R. Lin and J.-S. Liu, “ Routing in Ad Hoc Wireless Networks,” IEEE Journal on Selected Areas in Communications, vol. 17, no. 8, pp. 14261438, Nov./Dec. 1999.
9. V. Bhargavan, “A New Model for Packet Scheduling in Multihop Wireless Networks,” ACM Journal of Mobile Networks and Applications (MONET) vol. 9, no. 3, June 2004.
10. C. Zhu and M. S. Corson, “Routing for Mobile Ad Hoc Networks,” Proceedings INFOCOM 2002, New York.
11. T. Salonidis and L. Tassiulas, “Distributed dynamic scheduling for end to end rate guarantees in wireless ad hoc networks,” submitted for publication.
12. Y. Yang and R. Kravets, “Contention-aware admission control for ad hoc networks,” UIUC Tech Report, 2003.
13. Kui Wu and Janelle Harms “Support in Mobile Ad Hoc networks”, 2001.
14. Elizabeth M. Royer and Santa Barbar, “Review of Current Routing Protocols for Ad-Hoc Mobile Wireless Networks”, 2000.
15. C. E. Perkins and P. Bhagwat, “Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers”, Oct. 1994.
16. C.-C. Chiang, “Routing in Clustered Multi-hop, Mobile Wireless Networks with Fading Channel,” Proc. IEEE SICON ’97, Apr. 1997.
17. [C. E. Perkins and E. M. Royer, “Ad-hoc On-Demand Distance Vector Routing”,Feb. 1999.
18. [Zhanfeng Jia, Rajarshi Gupta, Jean Walrand and Pravin Varaiya, “Bandwidth Guaranteed Routing for Ad-Hoc Networks with Interference Consideration”, 2005 [online], p. 3-4.
19. [Rajarshi Gupta & Jean walrand, “Impatient Backoff Algorithm: Fairness in a distributed Ad-Hoc MAC”, [online], 2007.
20. R. Gupta, J. Musacchio, and J. Walrand, “Sufficient Rate Constraints for QoS Flows in Ad-Hoc Networks”, *Ad-Hoc Networks Journal*, accepted for publication, 2006.