

# **A Brief Survey on QoS based Routing Protocols for Real Time Multimedia Transmission in Wireless Systems**

**Maheshkumar Patil<sup>1</sup>, Dr. Siddesh Gundagatti<sup>2</sup>**

*<sup>1</sup>Jain College of Engineering & Technology, Department of Electronics and communication, Hubballi-580032, Karnataka, India.*

*<sup>2</sup>JSS Academy of Technical Education, Department of Electronics and communication Kengeri, Bangaluru-560060, Karnataka, India.*

## **Abstract**

In this paper we made an extensive survey of different protocols and techniques which tend to improve the Quality of service (QoS) in real time multimedia applications. This paper concentrates on both Mobile Ad-hoc Networks (MANETS) as well as Wireless Multimedia Sensor Networks (WMSN). QoS is being one of the important concepts in real time multimedia applications; users require different QoS at different times. The protocols for improving the QoS need to be adaptive in nature to satisfy the needs of the user.

Deadline constrained scheduling and transmission is very important to maintain the required QoS, if packets carrying real time multimedia data miss the deadline they become useless and are dropped. Both MANET and WMSN are Ad-hoc in nature, where networks are formed on demand, it is very important for protocols to be energy efficient, less delay, less jitter, high bandwidth utilization to improve the QoS.

**Index Terms:** Energy aware, MANETs, Packet scheduling, Routing, QoS, WSN.

## **I. INTRODUCTION**

In recent years we have witnessed rapid growth of multimedia usage in cellular systems and wireless sensor networks such live streaming, live TV, and many more. In these applications the packets carrying real time multimedia data have timing

constraints, because if packets reach the destination after the deadline they are useless and normally they are dropped, which degrades the Quality of Service, that's is why the improvement QoS has becoming a very important and challenging task for wireless engineers.

Real time data transmission in mobile ad-hoc networks is very challenging because of self-configuration of network on demand basis and mobile nodes are connected through wireless links. As nodes are mobile they frequently change their position, some nodes leave the network area and there is no infrastructure for the network. Therefore before transmitting any real time data we have to carefully we have to consider the challenges faced in MANET. The common challenges faced are energy in the network, how to scale down the network, finding the shortest route to the destination, how to deal with link failure and how to provide a greater security for multimedia data to improve the QoS.

Wireless sensor networks (WSN) consists of self-organized and linked sensors which are widely spread in a coverage area. Data is transmitted using multi hop routing protocols to the sink. As WSN came into existence they use to gather and transmit only the scalar data which needs only low bandwidth for communication. As these sensors cover a particular area and now coverage have become very complex only the scalar data is not sufficient, that's why support of media such as video and audio have become very important to accurately monitor the coverage are. In WSN main challenges faced are energy because sensors are battery driven and how to transfer data to the sink without degrading the QoS.

The rest of the paper is organized as follows. The section II deals with Survey of QoS protocols for MANETs. Different QoS protocols with respect to MANETs are compared in section III. The section IV concentrates on routing protocols for wireless sensor networks. Different QoS protocols with respect to WSNs are compared in section V. Section VI concludes the paper and gives required future directions for researchers in the field of QoS routing.

## **II. SURVEY OF QOS PROTOCOLS FOR MANETS**

Many routing protocols for MANETS have been briefly discussed in this literature. Carlos T. et. al [1], proposed architecture for MANET which supports real time peer to peer multimedia applications, authors mainly concentrated on adapting to applications with Bandwidth, jitter and delay constraints and tried to keep requirements minimum at intermediate stations. Mandeep Kaur Gulati et. al [2] in 2013 reviewed different protocols for MANET which includes Q-AOMDV, TDMA based routing protocols, sable and delay constrained routing, distributed slots reservation protocol and compared these QoS protocols on different metrics. Dr. R. Ashokan [3] reviewed single metric and multiple metric routing protocols.

Mahadev A. Gawas, et. al[4], proposed a cross layer multi QoS metric routing for multimedia traffic, which mainly focused on an Enhanced distributed channel access. Inter layer communication which is based on QoS platform for MANET is proposed

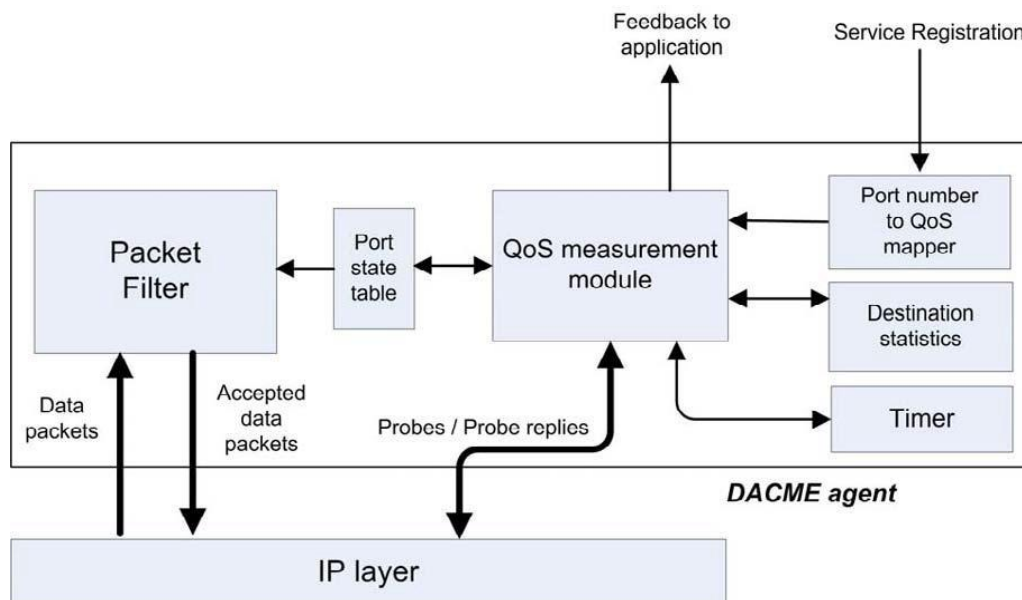
by Mamata Rathet. al [5] in 2013, talks about an algorithm at Network layer and a fast channel at MAC layer which uses Rate Monotonic scheduling scheme. J.N. Boshoffet. al [6] improved QoS for real time multimedia traffic in MANET by focusing on Delay Aware multipath routing scheme.

Even though a lot of work has been done on QoS in MANET, it seems less adequate in analyzing the QoS in different terms like Bandwidth, Multipath loss, deadlines, cross layer and balancing the load. The survey presented in this literature is the work done by different authors to improve the QoS.

**A. The Distributed Admission Control Mechanism**

DACME [1] is an admission control mechanism which performs end to end QoS measurement according to requirements of QoS for different multimedia streams. All the radio interfaces involved should be 802.11e enabled. Even though it's not a strict constraint only source and destinations should have a running DACME agent, intermediate nodes will consider the DACME packets as regular packets.

DACME agent block diagram is as shown in the fig.1 consists of QoS measurement module, which is responsible for accessing the QoS requirements along the path. Packet filter is another important component which restricts the traffic flow which should not enter in to the MANET by changing the TOS (Type of Service) field in the header of the packet depending on QoS requirements.



**Fig1. DACME Block Diagram**

The applications wishes to use DACME should register to a DACME agent, which includes indicating port numbers for source and destination, QoS requirement, IP address of destination these parameters are stored in a table which is indexed by port

numbers associated with nodes. Once the registration is done, QoS measurement module continuously does path probing to know the state of the paths in terms delay, jitter and available bandwidth. Destination agent will update the destination node's table upon receiving the probe packets, where it keeps information about received packets in that probe. Once the last packet is received destination agent informs the source DACME agent. The source agent will update the state path depending on the reply from destination agent, after sufficient information agent decides when connection should be rejected, accepted or preserved after checking all the registered connection towards the destination.

Packet filter is the component which helps to achieve the actual QoS required which depends on the port table which is formed by the agents; it changes the IP TOS field in the packet header depending on required QoS. The MAC must map the IP Type of Service field in to one of the four available categories Best effort, Voice, Video and Background.

### ***B. B.Q-AOMDV, TDMA based routing protocol, Sable and Delay Constrained Routing, Distributed Slots Reservation Protocol***

Q-AOMDV [7] provides QoS support in terms of hop count, bandwidth, and end to end delay in MANET. The protocol calculates the probability for each path depending on delay, hop count, bandwidth and gives preference depending on the probability.

To find the path to the destination the source sends Route Request (RREQ) packets in the MANET, the packets are flooded in the networks. Several duplicate packets will travel through different paths and reach the destination. This will help the source to find another way by knowing the alternative paths to the destination if primary path fails. The RREQ packet additionally adds hop count, bandwidth and delay in its header depending on which is the destination and which will be the primary path among all the paths. Destination will reply to the source through Route Reply (RREP). Whenever a node cannot send the packet to the next node, it will send Route Error packet to the upstream and downstream as well. Source will delete all the entries in that route and finds another route to the destination

TDMA based routing protocol [8] minimizes the neighbor count to increase the network throughput. As in TDMA media access is divided into time slots. Each time slot is assigned to a particular node, during this time neighbors of a sending node cannot send or receive from other nodes, if the path is chosen such that nodes in the path have less neighbor count, the result will more available time slots for each node to make connections. This protocol is based on AODV, which relies on discovery of route and its maintenance. Three parameters are considered during the discovery which are bandwidth, the number of neighbors of all the nodes included in the path and end-to-end delay. MAC layer updates these three parameters according to the information gathered. Two tables are maintained by each node routing and reverse routing table, first one to forward the packets and second one to forward confirmation of route back to source from destination. This protocol also uses Rote

Request (RREQ), Route Reply (RREP) and Route Error (RERR) same as previous one.

Stable and Delay Constraints Routing (SDCR) [9] protocol is extension of DSR, along with delay it also provides greater stability factor. SDCR carries out two phases' route discovery and maintenance. During the route maintenance it predicts the future of the link. In RREQ it added extra fields liketime stamp, delay constraint and link stability factor which depends on the location and velocity of nodes. In route maintenance phase SDCR keeps monitoring changes in the network topology by predicting the delay and reroutes before the route is unavailable for the communication.

K.P. Shih et. al [10] took hidden terminal and exposed terminal problem into consideration and proposed a bandwidth reservation based on demand TDMA based Distributed Slots Reservation Protocol(DSRP). The main concepts of the protocol are slot reuse and slot adjustment mechanism. When a source wants transfer data to destination route discovery phase will be initiated by broadcasting Route Request (RREQ) packet. During the phase, different slots will be selected for a link by slots inhibited policies (SIPs) and among these selected slots which slots needs to be used is decided by slot decision policy (SDP). Route Reply (RREP) packet is sent back to the source during this time reservation of slots takes place. During the route reply phase the slots which are reserved during discovery phase may be requested by other nodes, to avoid the rediscovery of the slots slot adjustment protocol (SAP) will be initiated which will schedule the slots of conflicted node with its neighbor's scheduling.

### III. COMPARISON OF QOS ROUTING PROTOCOLS FOR MANETS

The comparison of protocols for MANETs based on certain QoS parameters is shown in Table no 1.

**Table 1.** Comparison of QoS Routing Protocols

| Protocol           | QoS Parameters                            | Base Protocol   | MAC Layer protocol | BW and Delay Estimation | Delay                                   | Control Overhead   | Mobility                         |
|--------------------|---|---|--------------------|-------------------------|---|--|----------------------------------|
| DACME [1]          | End to end QoS measurement                | --  | DCF                | Done                    | Yes                                     | Yes  | Yes                              |
| Q-AOMDV [7]        | End to end delay, Hop count and bandwidth | Ad-hoc On-demand Multipath Distance Vector Routing protocol | IEEE 802.11        | Done                    | Reduced compared to base protocol AOMDV | Increased at lower speeds and decreased at higher speed with respect to AOMDV. | Better compared to Base protocol |
| TDMA based Routing | Delay and Bandwidth                       | Ad-hoc On-demand Distance                                   | TDMA               | Done                    | Reduced compared to base                | Depends on number of nodes.  | Less                             |

| Protocol  | QoS Parameters                  | Base Protocol           | MAC Layer protocol | BW and Delay Estimation | Delay   | Control Overhead   | Mobility  |
|-----------|---------------------------------|-------------------------|--------------------|-------------------------|---|--|---|
| [8]       |                                 | Vector Routing protocol |                    |                         | protocol AODV. Increased when compared to QoS AODV. | Increases as no. of nodes increase.  |   |
| SDCR [9]  | Delay and stability of the link | Dynamic Source Routing  | IEEE 802.11        | Done                    | Reduced compared to base protocol DSR.              | ---  | High  |
| DSRP [10] | BW                              | -                       | TDMA               | -                       | HIGH  | Compared to Lio's SAP protocol [11] control overhead is less but increases as traffic grows. | Compared to Lio's SAP protocol [11] mobility support is high. |

#### IV. SURVEY OF QOS PROTOCOLS FOR WIRELESS SENSOR NETWORKS

Many multipath routing protocols have been proposed for wireless sensor networks. As more multimedia content is being used to monitor the coverage of interest, the routing protocols are very much important topic of research nowadays. WSN are used for monitoring the area trust worthy QoS model is needed for communication [15]. In this section of the paper we have made a brief survey of some of routing protocols for real time multimedia transmission in wireless sensor networks.

**A.** Authors Cui Xiao Yan and Liu Chao [12] proposed a routing protocol for WSN, which will solve the problem of route resource wastage in flow based QoS routing. Competition for resources takes place when the same source begins transmitting two or more real time data flows to the same destination which leads to wastage of resources. To solve this variable port technique is used which will identify the different real time data flows, leading to wastage of resources in the route. The protocol uses a Ptime which determines the life time of a port and reduces the idle time in the path.

Routing process starts as follows, when source receives data from the upper layers it will investigate its routing table to find the path to the destination. If there is no path specified in the routing table it will assign variable port before sending the

route request message. When route request message reaches the mid node in the path, the middle node not only checks the source and destination address as well as variable port whether it is same or a different one. When route request message reaches the destination, route reply message from destination also contains the particular variable port so that source can understand which flow created a particular path using a variable port. To keep the variable port information, routing table should add variable port to its contents. While finding the path protocol should not only find the destination but also should compare the variable port to create a path for particular data flow. The protocol reduces the resource wastage and competition by assigning variable port to each different data flow from the same source to the destination.

- B.** Logambigai R and Kannan A [13] proposed a QoS aware Energy Efficient Routing (QEER) protocol for WSN. Wireless sensor nodes have limited power associated with them, so the power should be used very efficiently to increase the lifetime of sensor nodes. The protocol proposed by the authors takes hop count and energy in nodes into account. The proposed protocol forms clusters by grouping nodes and cluster heads are only permitted to do the routing which in turn reduces the energy consumption.

### **The QEER works in three phases:**

#### **1. Tree formation**

Tree formation starts when sink node broadcasts the Hop count message (HCOM) by means of flooding. The message consists of two fields NID and Hop count. NID is identification of the node which sends the message and hop count is the number of hops. When other nodes receive the HCOM packet they will verify the hop count in the message and increment it by one before forwarding it to its neighbors. Till the network is formed HCOM message is forwarded and during this phase each node will calculate the probability of it being a coordinator in the cluster depending on initial energy level and left over energy level.

#### **2. Formation of cluster**

Whenever there is an event, the coordinator will be chosen such that it should have less hop count and highest probability of being a coordinator.

#### **3. Route establishment**

Route establishment is initiated by coordinator by sending Route message RM, coordinator will send RM to its next hop and it forward to its next hop till sink is reached and this route will be used for the transmission of data.

C. Abdullah Bamatraf, Mohmmad Shafic and Yahala Walibaly [14] proposed a routing protocol, which adjusts itself depending on heterogeneous traffic. The authors concentrated on low latency and tried to fulfill the requirements of QoS in different network conditions. The proposed algorithm considers different specifications like distance to the sink, energy, history of the node, delay, and calculation of possibility of getting a link by a node at different densities of traffic.

WSN are used for different applications which include habitat monitoring, tracking, health care and intelligent transportation systems, from each of these applications different types data is produced, these data have to be classified in to different categories. The protocol proposed by authors first classifies the packets into four categories which depend on latency and reliability.

**Table 2.** Categories of traffic [14]

| Traffic Type    | Delay     | Loss         | Priority    |
|-----------------|-----------|--------------|-------------|
| Critical        | Critical  | Intolerant   | Highest     |
| Delay sensitive | Critical  | Low Tolerant | High        |
| Reliable        | boundless | Intolerant   | Moderate    |
| Normal          | boundless | Tolerant     | Best Effort |

The protocol uses a HELLO packet to get the required information for adapting itself to the traffic. The HELLO packet contains information about nodes like reliability, number of error rates, and latency along with them the geographical information of each node the packet visited. When a node's energy level drops below the threshold level, a critical message will be sent to its neighbors informing them that no node should send the packet to the present node. This protocol also holds the neighbors table and judges the quality of nodes depending on residual energy, nodes coordination, how many times nodes failed to get access of channel, packet queuing, success of delivery ratio, location of neighbors and local parameters. The algorithm divides the arriving packets into 2 types of queue. Real time and non-real time queue. The packets with are critical and delay sensitive information are transferred through real time queue else others are transferred through non real time queue. A packet scheduler applies highest priority to real time packets and low priority to non-real time packets. The proposed algorithm tries to solve the QoS problem by first categorizing the packets and deciding which queue to use for delivering the packets.

## V. COMPARISON OF QOS ROUTING PROTOCOLS

Comparison of above discussed protocols is done in TABLE no.3

**Table 3.** Comparison of above protocols

| Protocol | QoS Metrics  | Energy efficient  | Scalability   | Complexity  |
|----------|--|---|---|---|
| A        | Efficient use of Resources   | No  | Scalable because each data flow will have its own path to reach the destination | Complexity increases because each data flow should be assigned a variable port to form different path.  |
| B        | Energy and life time of sensors.   | Yes, forms cluster and only cluster head is allowed to do routing.  | Scaled down by forming the clusters.  | Increases because the node cannot be the coordinator for long time. Each time an event occurs depending on initial and left over energy cluster head will be chosen |
| C        | Differentiating the data in to different categories, defining two queues.<br>Bandwidth and Resource allocation | Yes, When a node's energy level drops below the threshold level, a critical message will be sent to its neighbors informing them that no node should send the packet to the present node. | Yes, by forming two queues for real time and non-real time data traffic.        | Increases because the data packets have to classify into categories every time, decide whether real time or non-real time queue to use.                             |

## **VI. CONCLUSION**

The emergence of real time multimedia data in wireless Ad-hoc networks and wireless sensor networks has attracted several researchers across the globe. Researchers have addressed this issue by developing different routing protocols which try to improve the QoS. In this survey we have presented different existing protocols in detail for both mobile ad-hoc networks and wireless sensor networks. The comparison between the discussed protocols has been presented. MANET protocols are compared. Solving the existing QoS routing issues require the design and development of new QoS routing protocols in MANETs and WSNs which will allow future ad-hoc networks and wireless sensor networks to meet user expectations.

## **REFERENCES**

- [1] Carlos T. Calafate, Juan-Carlos Cano, Pietro Manzoni and Manuel P. Malumbres, "A QoS architecture for MANETs supporting real-time peer-to-peer multimedia applications," Proceedings of the Seventh IEEE International Symposium on Multimedia (ISM'05).
- [2] Mandeep kaur Gulati, Krishan Kumar, "A Review of QoS routing Protocols in MANETs", 2013 International Conference on Computer Communication and Informatics (ICCCI -2013), Jan. 04 – 06, 2013, Coimbatore, INDIA
- [3] Dr.R.Asokan, "A Review of Quality of Service (QoS) Routing Protocols for Mobile Ad hoc Networks," International Conference on Wireless Communication and Sensor Computing 2010.
- [4] Mahadev A. Gawas, Lucy J.Gudino, K. R. Anupama "Cross Layer Multi QoS Metric Routing forMultimedia Traffic in 802.11E Over MANETs,"2016 Eighth International Conference on Ubiquitous and Future Networks (ICUFN).
- [5] Mamata Rath, Binod Kumar Pattanayak, Bibudhendu Pati "Inter-Layer Communication Based QoS Platform forReal Time Multimedia Applications in MANET," Wireless Communications Signal Processing and Networking 2016.
- [6] J.N. Boshoff, A.S.J. Helberg, "Improving QoS for Real-time Multimedia Traffic in Ad hoc Networks withDelay Aware Multi-path Routing," 978-1-4244-1870-1/08 2008 IEEE.
- [7] J Chunxue Wu, Fengna Zhang, Hongming Yang, "A Novel QoS Multipath Path Routing in MANET," International Journal of Digital Content Technology and its Applications Volume 4, Number 3, June 2010
- [8] David Espes, Zoubir Mammeri, "Delay and Bandwidth constrained Routing with Throughput optimization in TDMA-based MANETs," 978-1-4244-6273-5/09©2009 IEEE.
- [9] Peng Yang, Biao Huang, "QoS Routing Protocol Based on Link Stability with

- Dynamic Delay Prediction in MANET”, 2008 IEEE Pacific-Asia Workshop on Computational Intelligence and Industrial Application, 978-0-7695-3490-9/08 © 2008 IEEE.
- [10] K.-P. Shih and C. -Y. Chang and Y. -D .Chen and T.-H. Chuang, “Dynamic bandwidth allocation for QoS routing on TDMA-based Mobile ad hoc networks,” *Computer Communications* 29(9), pp. 1316-1329, 2006.
- [11] C. Zhu, M.S. Corson, “QoS routing for mobile ad hoc networks,” in *Proc.IEEE INFOCOM*, the Annual Joint Conference of the IEEE Computer and Communication Societies, vol.2, pp. 958–967, 2002
- [12] Cui Xiao-yan,Liu Zhao “An Improved Algorithm for Flow-Based QoS Routing Protocol in WSN,” 978-4244-4076-4/09©2009 IEEE.
- [13] Logambigai Rand Kannan A, “QEER: QoS aware Energy Efficient Routing Protocol for Wireless Sensor Networks,” 2014 Sixth International Conference on Advanced Computing (ICoAC).
- [14] Abdullah Bamatraf, Mohammad Shafie Bin Abd Latiff, Yahaya Coulibaly, “Priority based QoS Protocol for Heterogeneous Traffic Routing in WSNs,” 978-1-5090-6255-3/17/©2017 IEEE.
- [15] Wang Na<sup>1</sup>, Wang Tianhua<sup>2</sup>, “A trusted QoS routing model for wireless sensor networks,” *The 10th International Conference on Computer Science & Education (ICCSE 2015)* July 22-24, 2015. Fitzwilliam College, Cambridge University, UK

