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Appraisal of QOS Metrics of DSR/AODV/RPAR Protocols in Wireless Multimedia Sensor Networks

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Abstract: *The requirement for elevated data-rate multimedia wireless communication has been increasing rapidly. As standards are addressing higher capacity wireless links to meet increasing demands, as well as the consumption of device power is also increasing rapidly. A wireless sensor network has many inimitable characteristics such as intensive node deployment, higher unreliability of sensor nodes, asymmetrical data transmission, computation and stern power. The memory constraint present many new challenges for the development and eventual application of wireless sensor networks. In meticulous, sensor nodes are usually battery-powered and should operate for a long period of time. In most cases, it is not possible to change or recharge batteries for these sensor nodes. Thus, to increase the network lifetime, the Hexanode-RPAR framework has been adopted. The performance of the framework is validated for DSR, AODV protocols, and compared their performance with the Hexanode RPAR framework. It is evaluated through the parameters like throughput, delay, data dropped ratio, network load and retransmission attempt parameters.*

Keywords: *RPAR, WMSN, Hexagonal deployment*

I. Introduction

The advancement in wireless communication technologies enabled large scale wireless sensor networks (WSNs) deployed [1].Wireless sensor networks (WSNs) have a vast collection of applications in monitoring the surroundings [13]. Wireless sensor network is composed of a large number of sensor nodes. The activity is sensed by the low power sensor node deployed in the vicinity and the sensed information is transmitted to a base station [21]. It is not possible to deliver decisive real time information in wired networks, whereas wireless networks are utilized for data compilation and processing in authentic time from the circumventions [21]. The environmental conditions are quantified by sensors and then the dimensions are processed in order to react accurately according to the situation in the area around the sensors [6]. Over an astronomical area astronomically immense number of sensor nodes is deployed for monitoring the environmental conditions. An incrementation in the network size increases the coverage area, but data transmission, i.e., communication with the base station (BS) [3] is made potential with the avail of intermediate nodes with inhibited radio range. Wireless sensor networks are either deployed manually or randomly depending upon the application specification. The sensor nodes self-organize themselves and start communication by sending the data. Access to wireless sensor networks through internet is expected within 10-15 years [1]. There is an interesting unlimited potential in the wireless technology with various application areas along with crisis management, transportation, military, medical, natural disaster, seismic sensing and environmental. There are two main applications of wireless sensor networks which can be categorized as: monitoring and tracking. As there is no fixed transfer between wireless sensor networks for communication, routing becomes an issue when a large number of sensor nodes are deployed[31]. There are diverse protocols that have been projected for these issues [7]. In the preceding, the network has been scrutinized impartially by measuring a number of criteria to decide the network excellence. This quantification is known as the Quality of Service (QoS) of the network. The term QoS refers to the ability of the network to achieve more deterministic behavior, so that data can be transported with a minimum packet loss, delay and maximum bandwidth. One should note that QoS does not consider the user's perception [5].

II. Deployment Of Nodes And QOS Analysis

2.1 Deployment of Nodes

Hub sending methodologies are arranged into two noteworthy classes, i.e. irregular sending and deterministic organization of nodes [9].

2.1.1 Random Node Deployment: Random hub sending disperse the hubs on those areas which are experimental. Irregular hub sending is done by tossing sensor hubs arbitrarily on nature from the air, which creates incredible changes in hub thickness in light of the fact that a few hubs are put both farther and closer to one another [4].

2.1.2 Deterministic Node Deployment: The positions of hubs are predefined in the Deterministic hub organization, i.e. the sensor hubs are sent in the figured positions just. The deterministic sending is employed in operations where the arrangement range is really reachable. At the point when contrasted with irregular organization, this technique utilizes a lesser number of hubs to wrap a territory. Thus, it is more ideal when contrasted with arbitrary organization.

There are three noteworthy classes in deterministic hub arrangement strategy for organization of sensor hubs, i.e. triangle framework, square lattice and a hexagon matrix technique which are examined by considering the number of obliged hubs, scope, postponement and vitality utilization.

2.1.2.1 Triangle grid deployment:

In triangle framework arrangement, the aggregate scope territory is partitioned into little triangles where hubs are sent at the corners of every triangle [16]. All sides of the triangle are of equivalent likelihood.

2.1.2.2 Square grid deployment:

In square grid deployment, the total coverage area is divided into small squares where nodes are deployed at the edges of the square grid.

2.1.2.3 Hexagon grid deployment:

In the hexagon network arrangement technique, hubs are set on the six edges of the hexagon

Choice of Hexanode organization :

The principle focal point of hexagonal hub has, more scope region with less computational expense and less power utilization. The primary impediment with media sensor system whereas the point at which the quantity of hubs will be expanded, the scope range and reach blunder were decreased [3]. To beat this, the quantity of sides in the border of the entire scope, territory has been expanded by the method of hexagonal arrangement as illustrated in Fig.1.

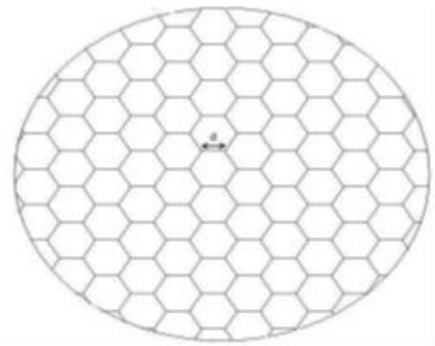

Fig.1. A standard hexagonal grid based node deployment.

2.2 QoS Support

QoS can be attained by considering affirmation control, approach chief, activity classes, and lining components [34].Wireless Local Area Networks (WLANs) and Broadband Wireless Access Networks (BWANs) are foundation based remote systems, which are the expansion of wired systems, so that the associations can be stretched out to versatile clients [35].QoS difficulties are essentially because of the lack of transmission capacity and the intricacy of client versatility through the keep going remote bounce.

2.3 QoS Requirements

A Wireless sensor system is an accumulation of a extensive number of sensor hubs spread over the domain. Each has the capacity of gathering information about the surrounding condition and convey it to a defined sink hub [30].Since there exist a numerous imagined applications in WSNs and their QoS prerequisites which may be altogether different and it is difficult to investigate them exclusively [32].Also, it is impossible that there will be an "one-size-fits-all "QoS help answer for every application.

For this reason, we depict a QoS in WSNs as:

(i) Application-particular QoS:

Application particular QoS considers parameters such as scope [19], presentation [20], estimation mistakes, and ideal number of dynamic sensors [12].

(ii) Network QoS:

Every application can't be investigated in WSNs, consequently it is sufficient to break down every class of applications arranged by information conveyance models [34], for most applications in each one class has normal necessities on the system . In general, there will be three essential information conveyance models, i.e., occasion driven, question driven, and persistent conveyance models [25] which give some components that describe as takes after :

1) Data Dropped: The total size of higher layer data packets (in bits/sec) dropped by the network due to:
2) Full higher layer data buffer, or
3) The size of the higher layer packet, which is greater than the maximum allowed data size.
4) End-to-End Delay: The performance may be end-to-end or non-end-to-end depending upon the applications. This includes Medium access delay at the source and reception of all the fragments individually.
5) Network Load: Represents the total data traffic (bits/sec) received by the entire network from resource to target.
6) Retransmission attempt: Total number of retransmission attempts by each and every nodes in the network until either packet is successfully transmitted or it is discarded as a result of reaching short or long retry limit.
7) Throughput: Total number of successful bits received by the destination node in the network.

III. Proposed Work

In this paper, we explain the various types of energy efficient related protocols based on performance, network delay, throughput, less power consumption, etc. Here we present a brief review of different routing protocols like AODV/DSR/RPAR[10].

3.1 AODV Routing Protocol [25]:

3.1.1 Introduction

There are two types of routing protocols which are reactive and proactive[2]. In reactive routing protocols the routes are created only when a source wants to send data to the destination whereas proactive routing protocols are table driven. Being a reactive routing protocol AODV uses traditional routing tables,one entry per destination and sequence numbers are used to determine whether routing information is up-to-date and to prevent routing loops.

3.1.2 Route Maintenance

The maintenance of time-based states is an important feature of AODV which means each routing entry which is not recently used is expired. The neighbors are notified in case of route breakage [11]. The discovery of the route from source to destination is based on query and reply cycles and intermediate nodes store the route information in the form of route table entries along the route [36]. Control messages used for the discovery and breakage of the route are as follows:

(i) Route Request Message (RREQ)
(ii) Route Reply Message (RREP)
(iii) Route Error Message (RERR)
(iv) HELLO Messages.

3.1.2.1 Route Request (RREQ):

A route request packet is flooded through the network when a route is not available for the destination from the source[12]. The parameters which are contained in the route request packet are presented in the following Table 1:

Source Address	Request ID	Source Sequence Number	Destination Address	Destination Sequence Number	Hop Count

Table 1: Route Request Parameters

A RREQ is identified by the pair source address and request ID, each time when the source node sends a new RREQ and the request ID is incremented. After receiving of the request message[1], each node checks the request ID and source address pair. The new RREQ is discarded if there is already RREQ packet with the same pair of parameters

a. A node that has no route entry for the destination, it rebroadcasts the RREQ with incremented hop count parameter.
b. A route reply (RREP) message is generated and sent back to source if a node has a route with sequence number greater than or equal to that of the RREQ.
c.

3.1.2.2 Route Reply (RREP):

From Table 2: a valid route to the destination or if the node is a destination, a RREP message is sent to the source by the node. The following parameters are contained in the route reply message:

Source Address	Request ID	Source Sequence Number	Destination Address	Destination Sequence Number	Hop Count

Table 2: Route Reply Parameters.

3.1.2.3 Route Error Message (RERR):

The neighborhood nodes are monitored. [13]When an active route is lost, the neighborhood nodes are notified with the route error message (RERR) on both sides of the link.

3.1.2.4 Hello Messages:

The HELLO messages are broadcasted in order to know neighborhood nodes. The neighborhood nodes are directly communicated. In AODV, HELLO messages are broadcasted in order to inform the neighbors about the activation of the link. These messages are not broadcasted because of short time to live (TTL) with a value equal to one.

3.1.3 Discovery of Route:

When a source node does not have routing information about the destination, the process of the discovery of the route starts for a node with which source wants to communicate. The process is initiated by the broadcasting RREQ message. On receiving the RREP message, the route is established. If multiple RREP messages with different routes are received, then the routing information is updated with a RREP of greater sequence number.

3.1.3.1 Reverse Path setup:

The reverse path to the node is noted by each node during the transmission of RREQ messages. The RREP message travels along this path after the destination node is found. The addresses of the neighbors from which the RREQ packets are received are recorded by each node.

3.1.3.2 Forward Path setup:

The reverse path is used to send a RREP message back to the source, but a forward path is setup during the transmission of RREP message. This forward path can be called as reverse to the reverse path. The data transmission is started as soon as this forward path is setup. The locally buffered data packets waiting for transmission are transmitted in FIFO-queue.

3.2 Dsr Routing Protocol[16]:

3.2.1 Introduction:

Dynamic Source Routing (DSR) convention will be particularly outlined for multi-bounce promotion hoc systems. The contrast in DSR and other directing conventions will be that it utilizes source steering, supplied by parcel's originator to focus a bundle's way through the system rather of autonomous jump by-bounce steering choices made by every hub.

The bundle in source steering will be set to be directed through the system. It conveys the complete requested rundown of hubs in its header through which the parcel will pass. Crisp directing data are not expected to be kept up in halfway hubs in configuration of source steering, since all the directing choices are contained in the bundle independent from anyone else.

3.2.2 DSR Route disclosure and Maintenance:

At the point when a hub S needs to send a parcel to end D, the course to end D is gotten by course revelation component [1]. In this instrument the source hub S shows a ROUTE REQUEST bundle, which in a controlled way is overwhelmed through the system and replied as ROUTE REPLY parcel by the terminus hub or from the hub which has the course to the objective. The courses are kept in the Route Cache, which to the same end can store numerous courses. The hubs check their path store for a course that could answer the appeal before the engendering of ROUTE REQUEST[14]. The courses that are not as of now utilized for the correspondence with the hubs, don't use exertion of getting or keeping up them i.e. the course disclosure is launched just on-interest.

The other system is the course support by which source hub S distinguishes if the topology of the system has changed so that it can no longer use its course to the destination[2]. On the off chance that the two hubs that were recorded as neighbors on the course left from the scope of one another and the connection gets to be broken, the source hub S will be informed with a ROUTE ERROR bundle. The source hub S can utilize some other known courses to the terminus D or the procedure; of course revelation is conjured again to discover another course at the end of the line shown in Fig.2.

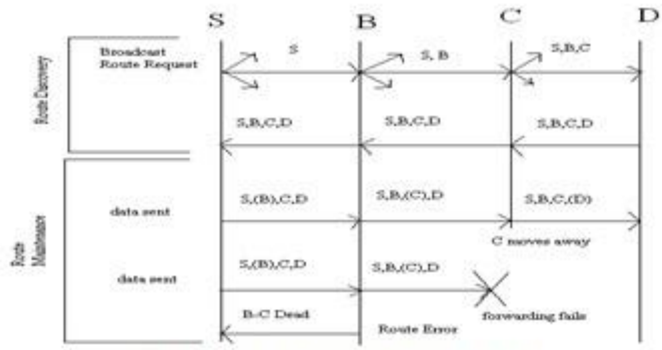

Fig.2 DSR route discovery and maintenance[15]

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1.3 Rpar Routing Protocol[25]:

3.3.1 Introduction:

Real time power aware routing protocol (RPAR) is the press forwarded version of RAP. The only protocol which is devised to sustain the real time routing for WSNs[1]. Machine exact correspondence deferrals are fingered in this convention by dynamically adjusting transmission power and steering declarations in view of the parcel targets.RPAR exercises promoting policy with neighborhood manager and power responsive that efficiently ascertains eligible vicinity node to forward the packet in WSNs.

3.3.2 Features:

The principle part of this conscientious convention is its versatility, i.e. for inflexible time limits, it exchanges vitality and ability to gather the longing time requirements, and for unfastened due dates, it lessens the transmission force to improve the throughput. The convention structural planning comprises of four segments as takes after:

3.3.2.1 Dynamic velocity: Dynamic velocity module, which sketches a packet deadline to an entailed packet velocity. At the point when a hub advances a bundle, it utilizes the speed module to subtract the required speed taking into account. The waiting separation between the present hub and the objective hub is the time to live (TTL) period. It additionally organizes the parcel taken into account foe ending the line.

3.3.2.2 Delay estimator: Delay estimator module, which scrutinizes the one-hop delay of diverse forwarding choices.

3.3.2.3 Forwarding: Forwarding module composes forwarding decisions on a packet-by-packet. It advances the bundle to the larger part vitality proficient sending decision that gathers the obliged speed of the parcel.

3.3.2.4 Neighborhood manager: Neighborhood manager proficiently holds the neighborhood table and affords the best neighbor for the transmission of packets. On the off chance that there are no data in neighborhood table about entitled forwarding hub, then the area supervisor is hurled to find the sending decisions with two system power adjustment and neighbor disclosure.

3.3.2.5 Power adaption: In the power adjustment conspire, the obliged speed for the subsisting neighbors in the area table is carried out by enhancing the transmission power. In this methodology, new neighbors are revealed that amass the entailed velocity by sending the Route to Request (RTR) parcels to the neighbor hubs. The projected power adaption and neighborhood systems are stipulated thus this convention is said to be a responsive convention. This responsive weaving machine is useful in finding neighbors quickly with low control overhead. This convention addresses vital practical issues like broken connections, transfer speed requirements and adaptability. Concert results demonstrate that this protocol achieves well regarding vitality utilization and deadline neglect degree.

IV. Simulation Parameters And Performance Metrics

In this paper, system test system, Optimized Network Engineering Tools have been used as a recreation domain. OPNET is a simulator built on top of the discrete occasion framework (DES) and it re-enacts the framework conducted by modelling. Each occasion in the framework are processed through client characterized procedures [33]. OPNET is compelling programming to re-enact heterogeneous system with different protocols. OPNET is an abnormal state user interface that is assembled as of C and C+ + source code with the immense library of OPNET capacity.

Adhoc Routing Protocol	AODV/DSR/RPAR
Simulating Time	5minutes
Protocol	UDP
Bandwidth	12MBps
Total No. Of Packets	1000
Application Rate	5MB
Application Type	Video Streaming
Service Type	Streaming Multimedia Type ID: 156
Network Region	176*162
Coverage area	50 meters

V. Result

The network consists of N number of nodes which are distributed in Hexagonal structure in the X*Y rectangular area, through wireless communication links. The simulation network of nodes is done under various energy aware based routing protocols i.e.AODV,DSR and RPAR as shown in Fig.3.,Fig.4.,Fig.5.,respectively.

Fig.3. AODV routing protocol

Fig.4. DSR routing protocol

Fig.5. RPAR routing protocol

5.1 Throughput

he graph shows the throughput for 50 nodes. RPAR retains with moderate throughput for whole period of transmission. The throughput is maximum when high amounts of load are transferred, and then it drops over a certain period of time due to the loss of packet/load. Comparing to other two protocols, AODV achieves higher throughput, but data drop after 2 minutes. Similarly DSR does the same performance as illustrated in Fig.6.

Fig.6. Time Vs. No.of Packets(Bits/sec)

5.2 Delay

The graph shows delay for 50 nodes. From the analysis of protocols, delay increases to the peak at a particular time where transmission of load is high. We bring to an end that the RPAR retains with moderate delay for whole period of transmission. Comparing to other two protocols, RPAR maintains moderate delay where delay is peak at 1 min 40secs and sustains moderate level for the whole transmission than the other two protocols as shown in Fig.7.

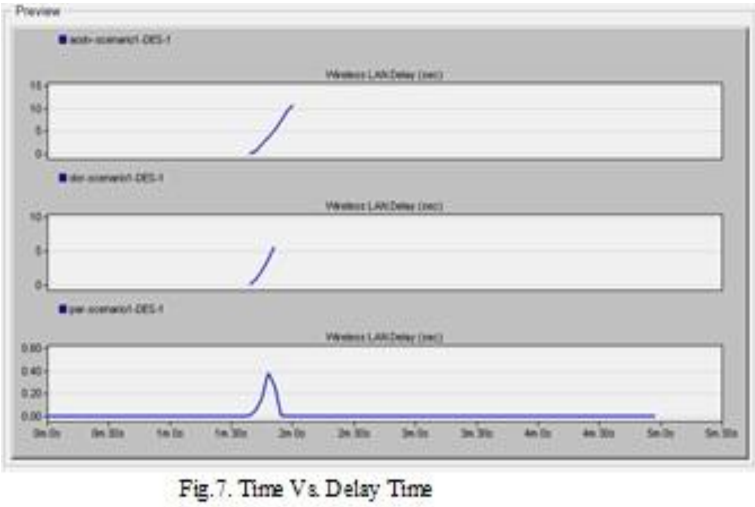

Fig.7. Time Vs. Delay Time

5.3 Data Dropped Ratio

From the analysis of protocols for data drop, when there is higher transmission of packets, data drop is also maximized. We come to an end that the RPAR retains with moderate data drop for whole period of transmission. Comparing to other two protocols, RPAR maintains moderate data drop than other two protocols which clearly shown in Fig.8.

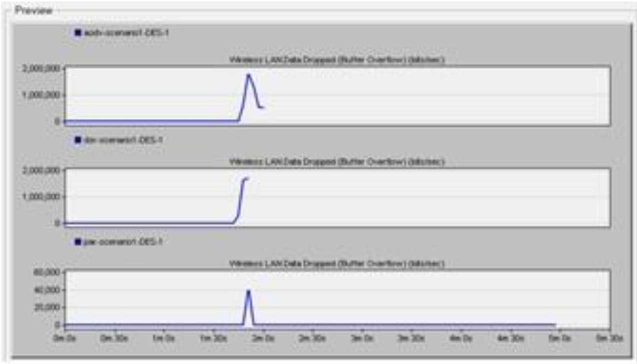

Fig.8. Time Vs. Dropped Packets(Bits/sec)

5.4 Network Load

The graph shows the network load for 50 nodes. From the analysis of protocols for the network load, we come to an end that the RPAR retains with higher network load for whole period of transmission comparing to other two protocols as shown in Fig.9.

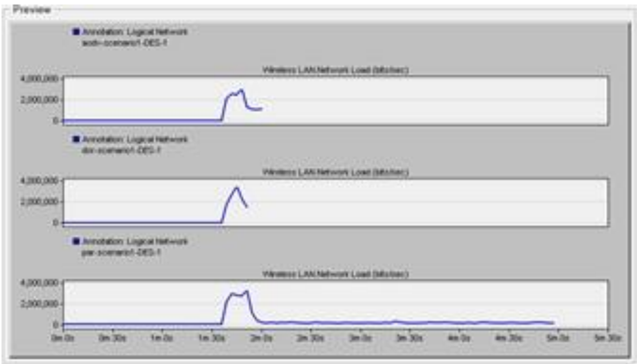

Fig.9. Time Vs. No.of packets(bits/sec)

5.5 Retransmission Attempt

Retransmission attempt is done only when there is packet drop in the network. From the analysis of protocols for retransmission attempt, we conclude that the RPAR attains higher retransmission attempt when compared to other two protocols since transmission rate is higher for RPAR routing protocol which is shown in Fig.10.

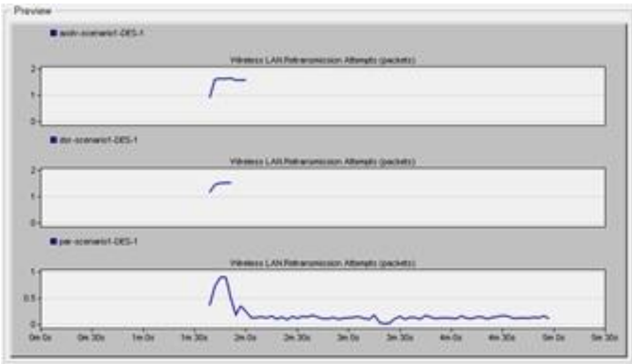

Fig.10. Time Vs.retransmission time

VI. Conclusion

In this paper, the performance of routing protocols, namely AODV, DSR, RPAR were analyzed in terms of QoS parameters such as End-to-End delay, throughput, Data dropped ratio, network load, retransmission attempt.The simulation was carried out by OPNET software by considering video signal generated by static nodes. It is obvious that the performance of routing protocol depends on the network scenario as well as the type of traffic used. It is observed from our simulation result that the Hexanode RPAR framework out performs DSR and AODV protocols for the video traffic generated by static nodes. The improvement in performance is due to the withstanding ability of the proposed framework in heavy load and traffic conditions when compared to AODV and DSR routing protocol. This work can be further extended to Heterogeneous traffic with mobile nodes.

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