DACP-QOS: DISTRIBUTED ADMISSION CONTROL-QOS ALGORITHM TO IMPROVE NETWORK PERFORMANCE IN MANET ENVIRONMENTS

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Abstract: *Mobile Ad-hoc Network (MANET's) environments greatly suffered from fluctuating connectivity conditions too broadcasting contention amongst the locations that adapt the situation. Although the several on-going endeavors, no meek as well as real explanation has been obtainable that can be simply organized also manage with the real-life environments and limitations. It is important to increase Quality of Service (QoS) and attain better performance in MANET environments. The QOS Aware Routing protocol (QOSAR) is used to discover backup routes for the active sessions and Link Disjoint Interference Aware (LDIA) QoS routing protocol based on MARIA is used to find multiple paths without any interferences. In this paper, a new distributed admission control procedure is proposed for improving QoS in MANET environment. This protocol called as Distributed Admission Control Protocol with Quality of service (DACP-QoS) uses the flow based on the per-hop basis. The proposed DACP-QoS greatly improves the QoS of the network. This protocol also supports multimedia applications in MANETs with minimum overhead. The proposed protocol achieved better performance than the existing QOSAR and LDIA protocol.*

Keywords:Admission Control, Adhoc On-demand Distance Vector (AODV),DACP-QoS, MANET, Multimedia applications

1. Introduction

Over the decade, the investigation on QoS provisioning in the MANET environment has augmented expressively. These systems can be accepted in viable surroundings in which there are hypermedia systems such as Internet Protocol Television (IPTV) and Voice over IP (VoIP)that permit the users to access hypermedia data. Also, these multimedia systems require better QoS such as bandwidth, delay, Packet Delivery Ratio (PDR), jitter, throughput, Packet loss rate, etc. An admission control system would be developed to establishment the end-to-end bandwidth demanded by the wireless hypermedia solicitations [1]. The significant workings on the QoS improvement in MANETs are QoS routing, QoS Medium Access Control (QoS-MAC), Power management, QoS provision, security and so on [2-5]. QOSAR [6] determines backup routes for active sessions by using both the node disjoint paths and link disjoint paths. In LDIA, QOSAR routing protocol[7], [8] based on MARIA conventions, all nodes find data stream statistics via its interference neighbor node with the conflict graph also interchange HELLO messages. Because of the dynamic variations in MANET [3, 4],achieving better QoS is a puzzling job, as the current routes are unsuccessful and intransigent. The prominent features of mobile node are toward determining also conserve the path in network and provide QoS provision. The QoS provisioning typical does not afford QoS metrics due to the system complication and overhead. As an alternative of this, the proposed protocol implemented with retiring admission control and little complication. Due to the movement of nodes and shared wireless medium, it offers guaranteed QoS.

This paper proposes a DACP-QoS routing protocol to improve the QoS in MANET environment. The DACP-QoS is implemented over an AODV-QoS[6] routing protocol which uses a Route Request (RREQ) packet to maintain the route discovery process. DACP-QoS broadcasts the HELLO messages to estimate the number of nodes lying within the interference range of the sender node. This yields minimum overhead in the network. In addition, DACP-QoS achieves high throughput and low delay. DACP only use RREQ message of AODV-QoS[6] protocol. Hence, the DACP can minimize the complexity for establishing the QoS session. The simulation result indicates that DACP-QoS can achieve greater throughput, goodput and low latency, low delay, low routing overhead and complexity in the mobile environment.

The remaining sections of the article are systematized as follows. Section 2 discussed about the existing research works on the improvement of QoS in MANET. In Section 3, QOS metrics are discussed and protocol implementation is discussed in Section 4. Section 5 discussed about the performance analysis of proposed protocol and Section 6 presents the conclusion of this paper and future scope of the proposed work.

2. Related work

Ahn et al. [2]provided a brief survey about the admission control protocols to achieve QoS assurances and finding the network resources for wireless ad-hoc networks. Wang et al. [3] described about the designing of distributed admission control algorithms to deliver service differentiation in MANET. The QoS provisioning schemes for resource reservation are proposed [4], [5]. Youn et al. [1]discussed about the DACP based on AODV protocol. Various QoS mechanisms are proposed to sustain the network fidelity. Once there is any linkage break, probe wallets are mentioned on reselected paths to retain the path. Based on the obtainable resources, all nodes calculate the Quality of service constraints. The end-to-end route with the small interval between the packet arrival timing is investigated to calculate the route capability and improve the QoS provision. In [9], soft MAC architecture was implemented. The linkage capacities and delay among data transmissions are created between the MAC layer and the network layer. In this technique, the control overhead is a problem to provide QoS. The PAC procedure [10] is suggested related to CACP. This routing protocol uses submissive observing to calculate the available bandwidth on the knob by observing threshold rate in which Carrier Sensing (CS) area is fewer than CACP. Zhu and Imrich [11] were proposed a framework to achieve admission control and bandwidth reservation through the cross-layer collaboration between AODV-QoS protocol and IEEE 802.11 protocols. This method conveys incorrect assessment of bandwidth but the contention of nodes is measured within its communication region.Sanzgiri et al. [12]proposed the methods for defining the amount of intra-flow contention along the multihop paths.Anew admission control protocol using the accurate resource estimation and prediction techniques is proposed [13].A new admission control scheme is introduced for 802.11 adhoc networks [14].

3. QoS Metrics

As various applications need different necessities, related QoS metrics may differ from request to request. For multimedia applications, the main QoS parameters are bandwidth, jitter and delay. There are many challenging security requirements for military solicitations. For emergency search and salvage operations, they need network availability at any time in anywhere. Also Minimum energy consumption is the key parameter for the group communication in a conference hall. Hence battery life is the key QoS parameters are PDR or Probability of packet loss, overhead, delay, jitter, packet dropping ratio, throughput (or) capacity of the network.

The following QoS metrics are measured to improve QoS,

a)Packet Delivery Ratio
b) Delay
c) Jitter
d) Normalized Overhead
e) Packet Dropping Ratio
f) Throughput

4. DACP-QOS Protocol Implementation

Basically, in our DACP-QoS, all nodes receiving the *RREQ* packet initially finds whether the destination nodes of the *Route Replay (RREP)* packet lie in the interference area. The hop number in the RREQ packet is used to predict the hop number on the end-to-end route. The DACP-QOS protocol accomplishes Admission Control (AC) in the path finding progression. To calculate the end-to-end hop count, the proposed protocol requires the information about the first neighbor (f_n) and Second neighbor (s_n) nodes. At the end, we can apply the HELLO message stated in the QOSAR procedure. This decreases the number of a *RREQ* wallet in the path finding process. This shows that the proposed protocol yields minimum overhead to improve QoS of the network. The transmitted packets contains

Table 1 Transmitted Packet Format

Source address	Packet size	Required Bandwidth	Data sequence no.	Next hop address	Sink address

4.1 Admission Control

During the AC process, the node gets the RREQ wallet and it verifies whether the endpoint node lies inside the interference region. Then, the hop count of the first neighbor nodes and second neighbor nodes is predicted. Through HELLO messages in AODV protocol, it decreases the number of a *RREQ* packet during the path discovery for the QoS session to improve quality of the network.

4.1.1 The connectivity tables

Every nodes interferes the information about the first and second neighborhood nodes in the connectivity table as shown in Fig.1 and 2. The aim is to verify whether the conflict linkage, disturbs intra-flow system. Once a node creates the admission decision, the number of conflict links within its interference range is to be envisioned. By propagating HELLO control packets, the first neighbor nodes are establish directly whereas the high broadcast power is required to obtain the second neighborhood node. In this protocol, the HELLO control packet is used to deliver the information about the second neighbor nodes.

All nodes ensure the connectivity also broadcast the HELLO message which entail the data of its individual first neighbor nodes and it find the next neighbor nodes. This information is reconstructed intermittently in the subsequent neighbor table. The interference and transmission ranges of the nodes are different as shown in Fig.1 and Fig.2. The Outside circle indicates interference range of node A, and the inner dotted circles denote the transmission range of all nodes. It is noted that though the node J does not fall into second neighborhood of node A, there is no performance degradation in the network. The purpose is that while admitting the admission control decision in node A, the node J does not enter into the route. By inspecting the timestamp message, the node calculates the updated information of HELLO messages.

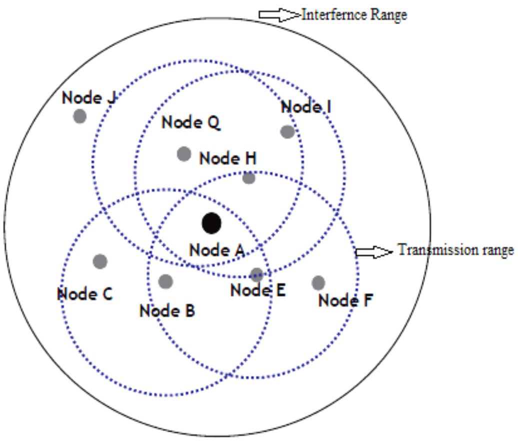

Fig.1 Connectivity nodes

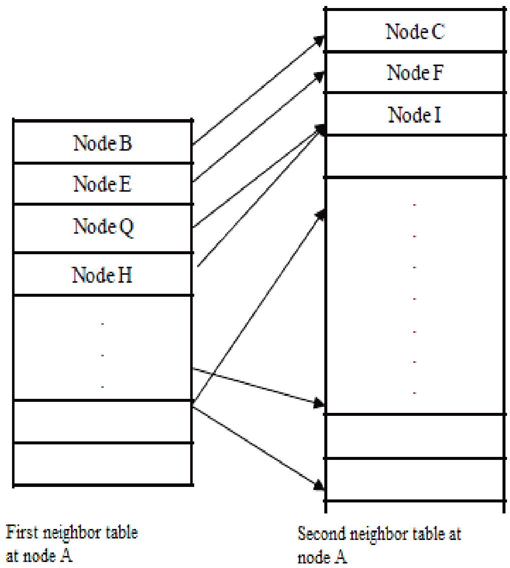

Fig.2 Connectivity tables of the first and second neighbor table of node A

4.2 Admission Control Algorithm for DACP-QoS:

To start the route finding process with MANET environs, the source node floods the *RReq* missive with the B_{req} (Required Bandwidth). From the destination IP (DestIP) in the neighborhood table, it regulates end - end hop number.

4.2.1 Admission Control Algorithm for Source node

Step1: Start the route discovery process with B_{req} and DestIP, set hop count==0.

Step 2: Verify the *DestIP* is in F_{nT}*(First neighbor node table)*

Step 3: If the *DestIP* is included in F_{nT} with hop *Count=0*, then check if the average bandwidth, $B_{ava}>B_{req}$, then broadcast *RREQ* with *hopcount+1*, otherwise purge the *RREQ* packet.

Step4: *DestIP* is in S_{nT} *(Second neighbor node table)*.

Step5: If the *DestIP* is included is in S_{nT} and check if the $B_{ava}>2B_{req}$, then broadcast *RREQ* with *hopcount+1*, otherwise purge the *RREQ* packet.

Step 6: $B_{ava}>3B_{req}$, broadcast *RREQ* with *hopcount+1*, otherwise purge the *RREQ* packet.

4.2.2 Admission Control Algorithm for Intermediate Node

Step1: Admit the data for admission control process with B_{req} and *DestIP*; initially *hop count==0*.

Step 2: Checks the *DestIP* is in F_{nT}

Step 3: If *DestIP* is included in F_{nT} and *hop count=1*, then check if the $B_{ava}>2B_{req}$, then broadcast *RREQ* with *hopcount+1*, otherwise purge the *RREQ*.

Step 4: If the *DestIP* is comprised in S_{nT} and the *hop count =1*, then check if the $B_{ava}>3B_{req}$, then broadcast *RREQ* with *hopcount+1*, otherwise purge the *RREQ*packet.

Step 5: If *DestIP* in the F_{nT} and the hop *Count >1*, then check if the $B_{ava}>3B_{req}$, then broadcast *RREQ* with *hopcount+1*, otherwise purge the*RREQ* packet.

Step 6: If the $B_{ava}>4B_{req}$, broadcast *RREQ* with *hopcount+1*, otherwise purge the *RREQ*.

4.2.3 Admission Control Algorithm for Destination node

Step 1: Start the admission control process with B_{req}, *DestIP*, *hop count==0.*

Step 2: If *hop count=1*, and check at destination node if $B_{ava}>B_{req}$, and then update the information in Table, otherwise purge *RREQ*.

Step 3: If B_{ava} at endpoint is greater than $2B_{req}$, and then update the information in Table, otherwise purge *RREQ*.

5. Performance Analysis

In order to evaluate more realistic performance of the proposed DACP-QoS, the simulations are run in the MANET environments. Around 50-200 dynamic nodes are located randomly in the 1000m × 1000m area. In the simulations, the packets are varied from (1500-2000) bytes in size. The source destination pair is randomly chosen and simulation is run for 200s. In the simulation process, the metrics used in measuring the performance of the proposed DACP-QoS protocol are PDR, jitter, delay, overhead and throughput.Table 2 shows the parameters used in the simulation process.

Table 2 Simulation Parameters

Parameters	**Values**
Number of nodes	50-200
Area	1000x1000
Node movement	Random
Routing	DACP-QoS, MARIA,
Node configuration	Adhoc routing
Propagation model	Two-ray ground model
Packet size	1500-2000
Traffic model	CBR
Simulation time	200s

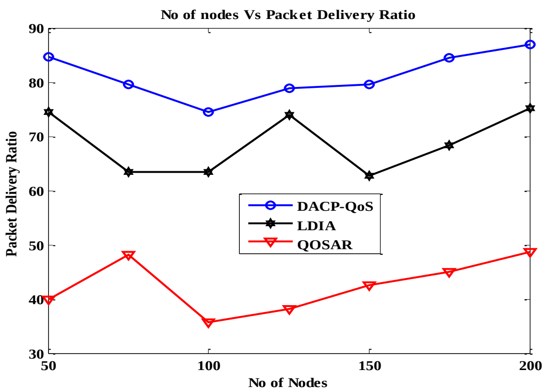

Fig.3 Number of nodes vs. Packet Delivery Ratio

Fig.3 shows the variation in the PDR of the proposed DACP-QoS protocol and existing QOSAR [6]and LDIA protocols [7] with respect to the number of nodes. The PDR of the proposed protocol is higher than the existing protocols. Thus, the network performance is improved.

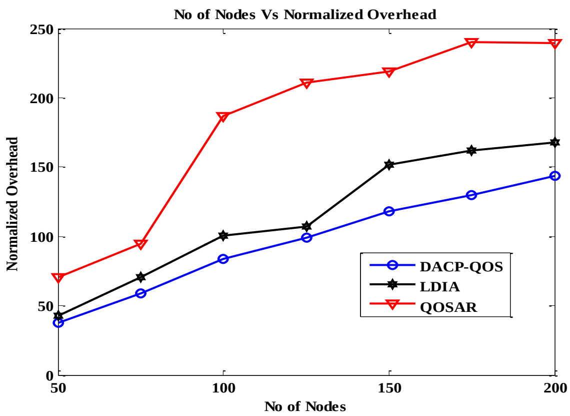

Fig. 4 Number of nodes vs. Normalized overhead

Fig.4 depicts the comparative analysis of normalized overhead for the proposed DACP-QoS and existing QOSAR and LDIA protocols. From Fig.4, it is observed that the proposed DACP-QoS protocol yields minimum normalized overhead to improve the QoS of the network.

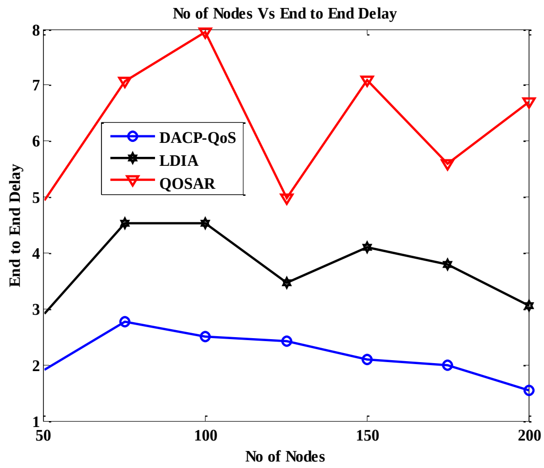

Fig.5 Number of nodes vs. End- End Delay

Fig.5 presents the end-to-end delay analysis of the proposed DACP-QoS and existing QOSAR and LDIA protocols. The end-to-end delay of the proposed protocol is lower than the existing protocols, because of finding the end-to-end bandwidth for the admission control process.

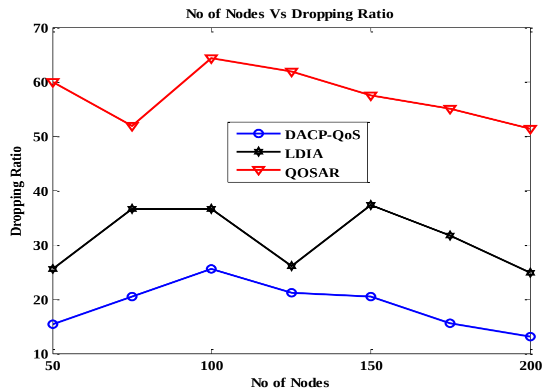

Fig.6 Number of nodes vs. Dropping Ratio

From Fig.6 and Fig.7, it is observed that the proposed protocol yields minimum packet dropping ratio and delay than the existing LDIA and QOSAR protocols.

Fig.8 illustrates the throughput analysis of the proposed DACP-QoS and existing protocols. The proposed protocol achieves maximum throughput than the existing protocols.

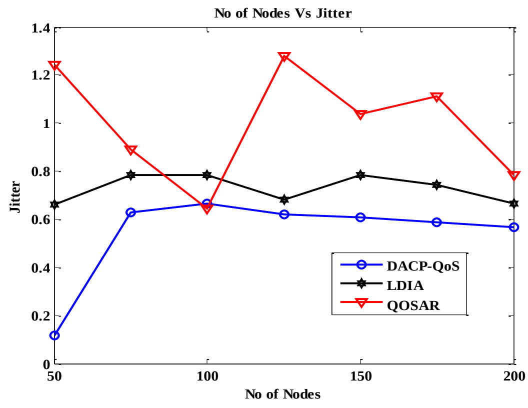

Fig.7 Number of nodes vs. jitter

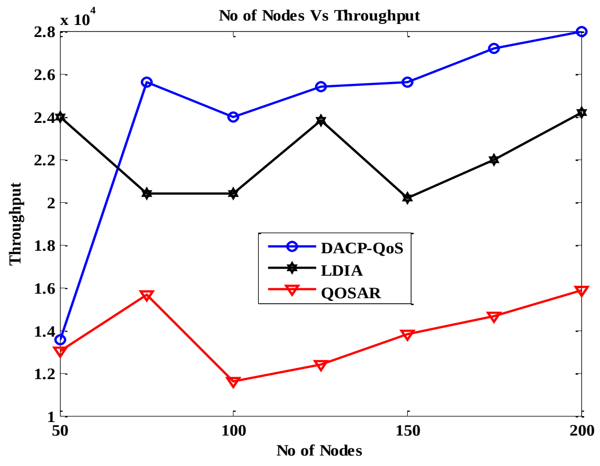

Fig.8 Number of nodes vs. Throughput

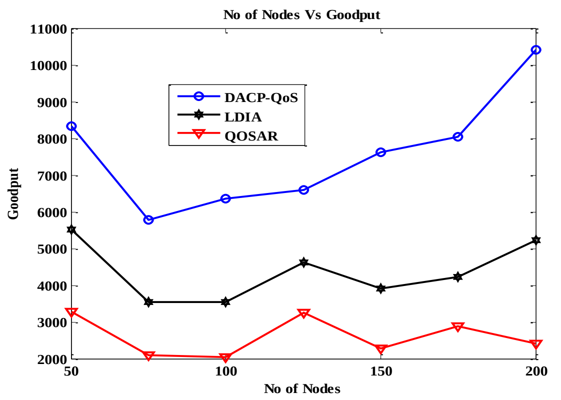

Fig.9 Number of nodes vs. Goodput

Goodput is defined as the rate of useful data delivered to a certain destination node in the network. Fig.9 shows the graph illustrating the variation in the goodput of the proposed DACP-QoS and existing QOSAR and LDIA protocols. The goodput of the proposed DACP-QoS is better than the existing QOSAR and LDIA protocols.

Table 3 Performance Analysis By Varying Packet Size

QoS Parameters	Packet Size	QOSAR	LDIA	DACP-QoS
PDR	1500	21.1667	79.7005	86.3561
	1600	23.3333	76.8719	79.3677
	1700	24.8333	76.5391	85.5241
	1800	24.1667	77.8702	79.5341
	1900	22.1667	74.3760	82.6955
	2000	20.3333	78.7022	82.6955
Delay	1500	4.616230	2.411080	1.738520
	1600	5.031020	2.429760	2.033960
	1700	5.070250	2.468130	2.047540
	1800	4.908020	2.596470	2.222070
	1900	4.647680	2.601260	1.931630
	2000	4.768120	2.539660	2.008900
Control Overhead	1500	11098	10217	10071
	1600	11057	10259	10150
	1700	11125	10259	10075
	1800	10978	10271	10081
	1900	11164	10289	10056
	2000	11172	10274	10063
Normalized Overhead	1500	87.3858	21.3299	19.4046
	1600	78.9786	22.2056	21.2788
	1700	74.6644	22.3022	19.6012
	1800	75.7103	21.9466	21.0900
	1900	83.9398	23.0179	20.2334
	2000	91.5738	21.7209	20.2475
Dropping Ratio	1500	78.8333	20.2995	13.6439
	1600	76.6667	23.1281	20.6323
	1700	75.1667	23.4609	14.4759
	1800	75.8333	22.1298	20.4659
	1900	77.8333	25.6240	17.3045
	2000	79.6667	21.2978	17.3045
Jitter	1500	1.377900	0.372090	0.345617
	1600	1.249030	0.385853	0.377433
	1700	1.173050	0.387528	0.349593
	1800	1.205660	0.381345	0.375349
	1900	1.315210	0.399969	0.362212
	2000	1.434760	0.377932	0.361573
Throughput	1500	8593.88	31933.3	34600
	1600	10096.8	32853.3	33920
	1700	11409.2	34755.6	38835.6
	1800	11748.5	37440	38240
	1900	11368.3	37746.7	41968.9
	2000	10971.2	42044.4	44177.8
Goodput	1500	2559.83	4366.49	7175.34
	1600	2442.32	4826	7977.5
	1700	2935.74	5339.53	7272.85
	1800	3017.66	5488.96	8147.38
	1900	3049.73	5894.11	9007.28
	2000	3349.53	6091.54	10316.7

Table 3 shows that the performance of QoS parameters with respect to the variation in the packet size. The proposed protocol yields maximum PDR, throughput and goodput and minimum delay, control overhead andnormalized overhead than the existing protocols. The proposed DACP-QoS protocol immensely improves the network performance.

Fig.10 shows the comparative analysis of packet delivery ratio for the proposed DACP-QoS protocol and existing QOSAR and LDIA protocols. By varying the data transmission interval, the proposed DACP-QoS protocol yields maximum PDR and minimum control overhead than the existing protocols.

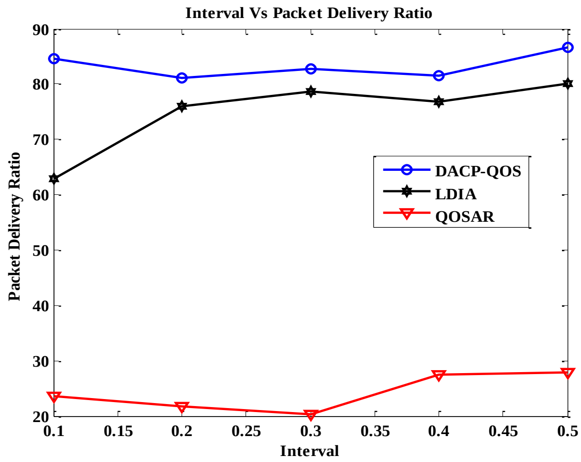

Fig. 10 Interval vs. packet delivery ratio

Fig.11 presents the graph showing the relationship between control overhead and data transmission interval for the proposed DACP-QoS protocol and existing QOSAR and LDIA protocols. The proposed DACP-QoS protocol requires minimum end-to-end delay than the existing protocols. Fig.12 show the variation in the end-to-end delay of the proposed DACP-QoS protocol and existing QOSAR and LDIA protocols with respect to the data transmission interval. The proposed DACP-QoS protocol yields minimum end-to-end delay and normalized overhead than the existing QOSAR and LDIA protocols. Fig.13 depicts the packet dropping ratio analysis of the proposed and existing protocols. By finding the end-to-end bandwidth for the admission control process, the packet dropping ratio of the proposed DACP-QoS protocol is minimum.

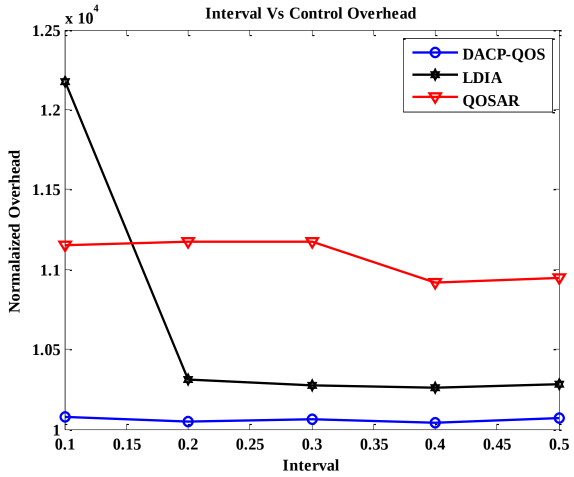

Fig. 11 Interval vs. Control overhead

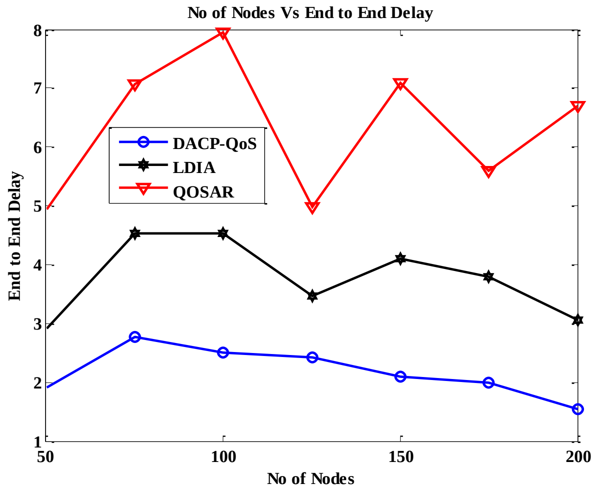

Fig. 12 Interval vs. End to End delay

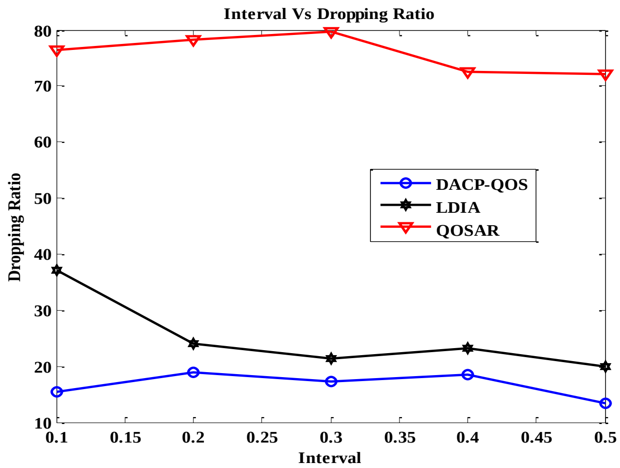

Fig. 13 Interval vs. Dropping ratio

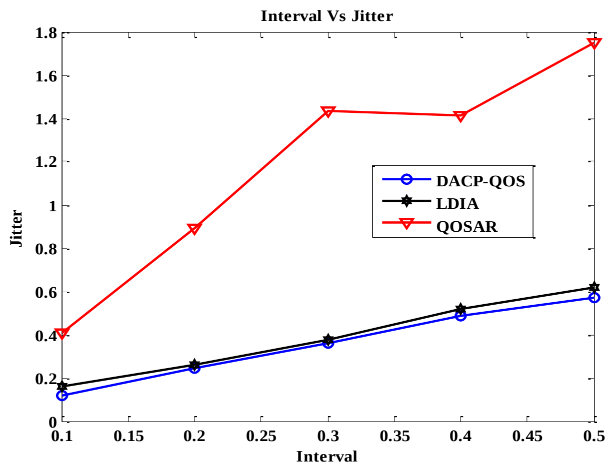

Fig. 14 Interval vs. Jitter

Fig.14 shows the comparative analysis of jitter for the proposed DACP-QoS protocol and existing QOSAR and LDIA protocols. The jitter of the proposed protocol is lower than the existing protocols. Fig.15 and Fig.16 present the throughput and goodput analysis for the proposed and existing protocols. The proposed protocol achieves maximum throughput than the existing protocols.

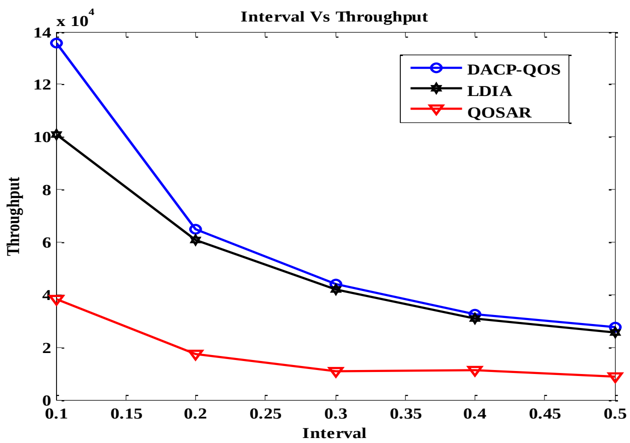

Fig. 15 Interval vs. Throughput

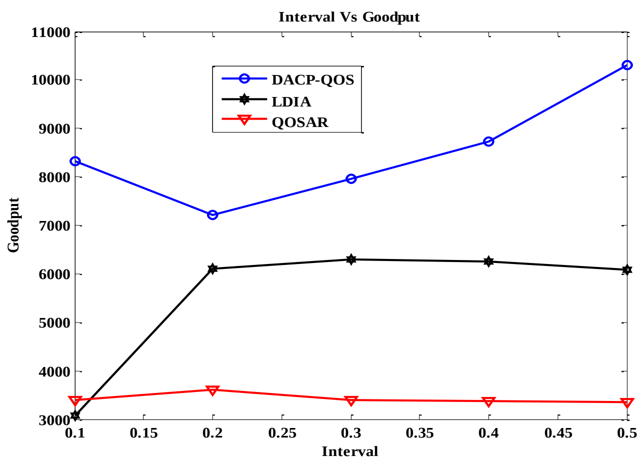

Fig. 16 Interval vs. Goodput

Table 4 Qos Analysis by Varying Simulation Time

QoS Parameters	**Simulation time**	**QOSAR**	**LDIA**	**DACP-QoS**
PDR	50	5.7143	54.5714	74.2857
	75	12.0000	62.1667	76.6667
	100	14.1176	63.1765	80.8235
	125	23.8182	63.6364	81.8182
	150	24.5185	61.6296	82.8148
	175	20.6875	59.9375	83.5625
	200	23.6535	62.9095	84.6752
Delay	50	8.46614	4.06257	2.25685
	75	7.83407	3.84213	2.35638
	100	6.65389	3.73559	2.21439
	125	5.68432	3.92197	2.12049
	150	5.31421	4.35364	2.04116
	175	5.31421	4.86086	1.96734
	200	4.77291	5.21926	1.92098
Control Overhead	50	2157	2635	2537
	75	3716	3960	3806
	100	5161	5406	5078
	125	6346	6991	6322
	150	7906	8797	7582
	175	9686	10564	8827
	200	11152	12175	10074
Normalized Overhead	50	107.85	13.7958	9.7577
	75	51.6111	10.6166	8.2739
	100	43.0083	10.0670	7.3916
	125	24.2214	9.9871	7.0244
	150	23.8852	10.5733	6.7818
	175	29.2628	11.0156	6.6021
	200	26.1784	10.7458	6.6059
Dropping Ratio	50	94.2857	45.4286	25.7143
	75	88.0000	37.8333	23.3333
	100	85.8824	36.8235	19.1765
	125	76.1818	36.3636	18.1818
	150	75.4815	38.3704	17.1852
	175	79.3125	40.0625	16.4375
	200	76.3465	37.0905	15.3248
	50	0.171269	0.162442	0.126153
	75	0.525943	0.150166	0.125626
	100	0.642191	0.151043	0.120586
	125	0.388574	0.151173	0.119735

Jitter	150	0.346753	0.157280	0.118818
	175	0.346753	0.162605	0.118057
	200	0.409191	0.159848	0.117665
Throughput	50	9260.74	87564.5	119198
	75	19424.4	99632.7	122871
	100	22841	101201	129470
	125	38525.2	101911	131028
	150	39651.3	98680.5	132602
	175	33451.9	95960	133784
	200	38245.3	100711	135556
Goodput	50	1908.78	3938.39	7089.54
	75	2062.78	4164.35	6790.07
	100	2428.65	4283.13	7225.47
	125	2842.91	4079.58	7545.41
	150	3040.91	3675.09	7838.68
	175	3040.91	3291.6	8132.82
	200	3385.78	3065.57	8329.08

Table 4 shows that the performance of QoS parameters by varying the simulation time. Our proposed DACP-QoS protocol immensely improves the network performance by achieving maximum PDR, throughput and goodput and minimum delay, control overhead andnormalized overhead than the existing QOSAR and LDIA protocols. Hence, the proposed protocol is found to be efficient than the existing protocols.

Table 5 Performance Analysis by Varying Data Time

QoS Parameters	**Data time**	**QOSAR**	**LDIA**	**DACP-QoS**
PDR	10	19.2488	60.5634	75.5869
	15	22.0000	61.6915	75.1244
	20	25.0000	69.1489	83.5106
	25	14.8571	62.5000	79.5455
	30	13.4969	71.7791	74.2331
Delay	10	8.05794	4.13527	2.54766
	15	8.07579	4.05956	2.97458
	20	7.17395	3.89873	2.51159
	25	6.69527	4.08477	2.65977
	30	7.79538	3.94947	2.67871
Dropping Ratio	10	80.7512	39.4366	24.4131
	15	78	38.3085	24.8756
	20	75	30.8511	16.4894
	25	85.1429	37.5	20.4545
	30	86.5031	28.2209	25.7669
	10	1.298980	0.641997	0.515718
	15	1.352160	0.629026	0.520188
	20	0.907682	0.573204	0.471961
	25	2.061350	0.631945	0.491670
	30	1.714040	0.540526	0.520249
Throughput	10	7813.21	24339.6	30377.4
	15	8932.66	24800	30200
	20	10154	27807.5	33582.9
	25	6036.78	25142.9	32000
	30	5486.42	28888.9	29876.5
Goodput	10	2005.48	3869.15	6280.28
	15	2001.04	3941.31	5378.91
	20	2252.59	4103.9	6370.46
	25	2413.64	3916.99	6015.55
	30	2073.02	4051.17	5973.02

Table 5 shows the performance of QoS parameters by varying data time (i.e.) Variable bit Rate (VBR). These results illustrate the QoS parameters of PDR, delay, jitter, throughput and goodput. The proposed DACP-QoS protocol greatly improves the network performance when compared to the existing QOSAR and LDIA protocols.

6. Conclusion and Future Work

In this paper, we propose a new admission control protocol called as DACP-QOS protocol to improve the QoS in MANET environments. The DACP-QoS makes admission control decisions by using the RREQ messages for route finding process. Hence, it can be reduce the routing overhead considerably.The proposed protocol improves QoS with minimum latency and high throughput. In addition that the QoS parameters are estimated and compared with the existing QOSAR and LDIA protocols based on MARIA. Simulation result shows that the proposed DACP-QoS protocol will improve the QoS in terms of throughput and service provision quality of the networks. This is mainly used for multimedia applications, IPTV and VoIP. In future, we improve the proposed DACP-QoS protocol with distributed priority schedule and use the interference less path for data transmission to achieve better network performance.

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