Dynamic Counter Angle-Based Broadcasting in CSMA-Based Wireless Networks

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Abstract**—**Building efficient ad hoc networks for wireless communications is challenging due to the dynamic nature of the hosts. Broadcast services in ad-hoc networks are critical to supporting various applications and protocols. However, the traditional broadcast protocol has caused the notorious "broadcast storm" problem in mobile wireless self-organizing networks. This phenomenon has been shown to greatly increase the network communication overhead and end-to-end delay. Various counter-based schemes have been proposed to mitigate the impact of this inherent phenomenon. In this article, authors propose a new Dynamic Counter Angle-based Broadcast Scheme (DCABS) that can dynamically compute the forwarding threshold at a node based on its neighborhood information. Experimental model assumes a CSMA-based static multi-hop ad-hoc network. Simulation results show that the new broadcast scheme achieves superior performance in terms of retransmitting nodes, business volume, throughput, and end-to-end average transmission delay without sacrificing reachability compared to the existing schemes.

Index Terms**—**Angle-based broadcasting, broadcast storm, counter, wireless ad-hoc network

I. Introduction

Broadcasting is a widely-used transmission scheme in wireless ad-hoc networks. It serves many important roles such as control message dissemination and route discovery in on-demand routing protocols. Broadcasting has traditionally been based on flooding, where each intermediate node that hears a packet for the first time rebroadcasts it while dropping all duplicated packets. The main advantage of a flooded solution is simplicity. However, a large amount of unnecessary retransmission greatly reduces the performance of this scenario. Although the simplicity and success rates of all nodes in the network are high, they can lead to redundant retransmission of messages. In dense networks, this redundant retransmission usually leads to high contention and conflict in the network, resulting in valuable bandwidth and battery loss, which is known as the broadcast storm problem [1], [2]. Many protocols have been proposed in the literature to improve the water efficiency, which is based on the reverse, distance based and location-based broadcast approach is the most widely available option for [3].

Counter-based broadcasting is based on the following simple argument: the fewer the number of times that a packet is received at a node, the more probable that the node is close to the areas uncovered by that packet. More specifically, each intermediate node hearing the broadcasted packet for the first time sets a random timer. When the timer expires, the number of copied packets received by the node is counted, and the group is replayed only if the number is less than the intended threshold. If the number is above the threshold, the group is not rebroadcast to prevent network retransmission from being more likely to be used for grouping other nodes. Performance evaluations show that the efficiency of this technique increases [4].

The angle-based scheme is a kind of position auxiliary broadcast scheme [5]. The coverage angle is calculated based on the nodes that have been forwarded over the broadcast message within the current communication scope. In addition, the larger the distance between the receiving and receiving nodes, the smaller the coverage area and the smaller the angle. The advantage of this scheme is that the network has a high accessibility, but it increases the delay of each node’s transport information.

Several broadcast schemes have been proposed in the past [6]-[9]. These include probability-based, counter-based, location-based, and distance-based schemes [7], [10], [11]. In probability-based scheme, a mobile node rebroadcasts a message according to certain probability while in counter-based schemes messages are rebroadcast only when the number of copies of the message received at a node is less than a threshold value. Pure probabilistic schemes assume a fixed probability value and it is shown in [3] that the optimal rebroadcast probability is around 0.65. However, these schemes assumed predetermined rebroadcast probabilities. Intuitively, these values are not likely to be optimal in other network settings because the performance depends also on other simulation parameters like topology size, transmission range, number of neighbors etc.

In this paper, we propose a new broadcast scheme which combines the functionalities of fixed counter and angle-based schemes, and also dynamically compute the forwarding counter-threshold value at a given node using a counter function that depend on neighborhood information which is estimated using neighbor location. The new

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scheme is compared against flooding, Counter-Based and Angle-Based schemes [5], [12]. Simulation results reveal that the new scheme achieves superior performance in terms of number of neighbor nodes, business volume, throughput and average transmission delay.

To the best of our knowledge, there is no analytical model to evaluate the performance of counter-based and angle-based broadcasting technique in more realistic scenarios. In this article, we mathematically model the dynamic counter angle-based broadcasting scheme in presence of a practical MAC layer protocol. We specially focus on deriving an upper bound on the coverage of broadcasting scheme. The analytical framework proposed in this paper is similar to [13]. However, the proposed framework applies only to simple floods, and in this article we consider more complex cases of inheritance from the more complex nature of dynamic inverse radio. In our analysis, assume a single source broadcast scenario. Based on the proposed framework, the number of propagation can also be estimated, which is a measure of broadcast energy consumption. The results of the simulation confirmed the closeness of the trusted upper limit.

The rest of the paper is organized as follows. Section 2 introduces the related work. In section 3, we present the new broadcast scheme. We evaluate the performance of the new scheme and present the simulation results in section 4. Finally, section 5 presents the conclusion of this paper.

II. Related Work

A. Mohammed *et al* [7] have proposed a new dynamic probabilistic counter-based broadcast scheme that can dynamically compute the forwarding probability at a node based on its neighborhood information. This scheme combines the functionalities of fixed probabilistic and counter-based schemes, and also dynamically compute the forwarding probability at a given using a probability function that depend on neighborhood information which is estimated using packet counter. The probability function uses the neighborhood information at a node (i.e. packet counter value) together with the threshold value.

Khalid Abdel Hafeez and Lian Zhao [14] have presented a geometric model to predict the recommended maximum range of a one hop broadcast message. In their work, they present a model to find the recommended maximum one hop range and thus to minimize the channel contention and the impact of the hidden terminal problem. They also propose a distributed scheme to alleviate the impact of the broadcast storm problem taking into account the network density and the received signal strength in favoring one node over the others to rebroadcast the message. Including the network density in calculating the rebroadcast probability and the waiting time is the major contribution of their research.

Lidan Lin [15] have proposed an adaptive broadcast scheme based on location and neighbor knowledge in ad hoc network. When node hears the transmissions from its neighbors, it will obtain a cover angle. Before deciding whether to forward the packet, it will predict the decision-making for its neighbors, which also has heard the same packet but not processed it, to adjust the covet angle. And then it calculates the forward probability according to this cover angle.

In recent work, Sang-woo Chang and Sang-sun Lee [8] have suggested the improved distance-based multi-hop broadcast scheme for inter-vehicle communication and applied two major approaches to exponential waiting time for faster collision avoidance dissemination of urgent messages and to high prioritized intersection waiting time for more probability of dissemination of messages toward out of intersections. In the same work, the proposed scheme improves the performance as compared with basic distance-based broadcast and distance-based multi-hop broadcast scheme guarantees not only rapid broadcast but also reliable probability of successful transmission.

Recently, Qiao Xiang *et al* [3] have proposed the concept of packet-value to quantify these data preferences. In the paper, they design PVCast, a packet-value-based safety data dissemination protocol in VANET, which makes the dissemination decision for each packet based on its packet-value and effective dissemination coverage in order to satisfy the data preferences of all the vehicles in the network. Simulation results in a typical highway scenario show that PVCast provides a significant improvement on per-vehicle throughput, per-packet dissemination coverage with small per-packet delay.

In this paper, we propose a new broadcast scheme referred to as Dynamic Counter Angle-Based Scheme (or DCABS for short) that dynamically compute the forwarding counter threshold at a given node using a counter function. The counter function uses the neighborhood information at a node together with the cover angle value. The detail of the DCABS together with its counter threshold function is described in the next section.

III. Dynamic Counter Angle-Based Broadcast Scheme

In DCABS, upon receipt of a packet that was not previously discovered, a node initiates a counter C that records the number of times a node has received the same packet. The selection of the threshold C of the counter has a great influence on the performance evaluation of the new algorithm. If the threshold value of the counter is too small, the number of times the information is forwarded by the node is small, resulting in a certain probability that the neighbor node can’t receive the destination information, thus affecting the normal communication function of the network. In contrast, from another point of view, if the counter threshold is too large, the node in the timer time range will increase the same broadcast packet forwarding times, and the occurrence of this situation may cause information redundancy Such as broadcast storms, reduce the efficiency of network transmission of information and damage the normal operation of the network. In the real network environment, the surrounding environment of each node in the network changes anytime, anywhere, so that each node for the counter forwarding threshold requirements are not the same, according to the node has been covered Range to dynamically adjust the counter threshold.

Through the research and analysis of the network architecture, it can be concluded that the coverage of the neighbor node in the neighbor node and the source node (sending the broadcast packet to the neighbor node) is very small, that is, the coverage angle range Very small, on the contrary, in the two nodes closer to the network, the greater the coverage angle. By analyzing the angle-based algorithm and the counter-based algorithm, it is found that when the coverage angle range of the node is larger, the additional coverage area will be smaller, and when the coverage angle range becomes smaller, the additional coverage area will be correspondingly increase. This means that when the coverage angle of the node is large, it indicates that the neighbor node has been covered to a large extent. When the neighbor node accepts more information, it needs to reduce the number of forwarding of the source node, thus reducing the redundant information and the occurrence of the situation. Therefore, in the design of the dynamic counting angle-based algorithm, it can be seen from the algorithm core function that the angle is proportional to the function relation of the counter threshold value, that is the larger the angle, the smaller the threshold value C will be, so the number of forwarding correspondingly smaller. So the value of the coverage angle directly affects the number of forwarding of the nodes, thus affecting the network data transmission and information broadcast.

A. *Relationship Derivation in DCABS*

According to the analysis of the angle-based algorithm, we can know that the nodes in the network can learn the current location information through auxiliary tools such as GPS. Assuming that the node N receives the broadcast packet from the node M for the first time, use the following method to calculate the coverage angle $\Theta(M,N)$ that the node N receives from the node M broadcast packet. The angle here is expressed in counterclockwise, and the coordinates are $M\left(x_M, y_N\right)$ and $N\left(x_M, y_N\right)$. Because of the relative position of the broadcast nodes, the method of calculating the coverage angle is different. $\Theta(M,N)$ can be represented by $\left[\angle ONM, \angle ONE\right]$, where E and F is the intersection of two circles with M and N as the center of the circle. The calculation method can be divided into the following cases [15]:

CASE 1: $\Theta(M,N)$ through horizontal line NO, below horizontal line NM.

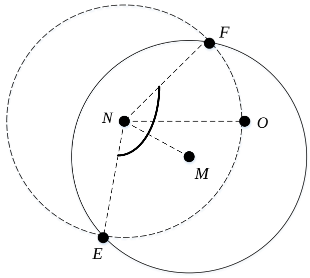

Fig. 1. The coverage angle $\Theta(M,N)$ of M in N communication range

Fig. 1 shows that $\Theta(M,N)$ needs to be divided into two intervals:

$$\begin{gathered}\Theta(M,N)=[0,\angle ONF]\cup[\angle FNE,2\pi]\\ \angle ONF=\angle FNM-\angle ONM\\ \angle ONE=2\pi-(\angle FNM+\angle ONM)\end{gathered}\qquad(1)$$

CASE 2: $\Theta(M,N)$ through horizontal line NO, above horizontal line NM.

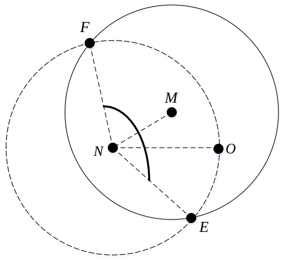

Fig. 2. The coverage angle $\Theta(M,N)$ of M in N communication range

Fig. 2 shows that $\Theta(M,N)$ needs to be divided into two intervals:

$$\begin{gathered}\Theta(M,N)=[0,\angle ONF]\cup[\angle FNE,2\pi]\\ \angle ONF=\angle FNM+\angle ONM\\ \angle ONE=2\pi-(\angle FNM-\angle ONM)\end{gathered}\qquad(2)$$

CASE 3: $\Theta(M,N)$ not through horizontal line NO ($\angle ONM-\angle FNM>0$).

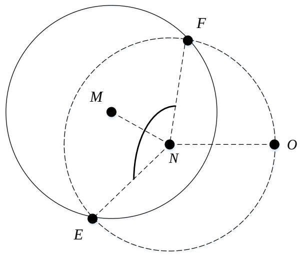

Fig. 3. The coverage angle $\Theta(M,N)$ of M in N communication range

As can be seen from Fig. 3:

$$\begin{gathered}\angle ONF=\angle ONM-\angle FNM\\ \angle ONE=\angle ONM+\angle FNM(\angle FNM=\angle MNE)\end{gathered}$$

$$\angle ONM = \cos^{-1}(\overrightarrow{NO} \cdot \overrightarrow{NM} / \left\|\overrightarrow{NO}\right\| \cdot \left\|\overrightarrow{NM}\right\|)$$
$$= \cos^{-1} \frac{(x_M - x_N)}{\sqrt{(x_M - x_N)^2 + (y_M - y_N)^2}} \quad (3)$$
$$\angle FNM = \cos^{-1}(\left\|\overrightarrow{NM}\right\| / 2R)$$
$$= \cos^{-1} \frac{\sqrt{(x_M - x_N)^2 + (y_M - y_N)^2}}{2R}$$

When the node N receives the packet k from the node M for the first time, it will generate a forwarding delay and start the timer T , calculate $\Theta(M,N)$ according to the above method. Before the timer times out, if the time $t_1(t_1 < T)$ has received the same broadcast packet from the node Z . The coverage angle of the node N at this time is $\Theta(N,k) = \Theta(M,N) \cup \Theta(Z,N)$.

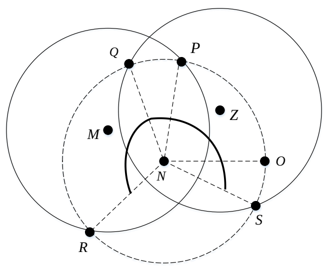

Fig. 4. The total coverage angle

As can be seen from Fig. 4, the node N receives the node M and Z duplicate package:

$$\Theta(M,N) = [\angle ONP, \angle ONR]$$
$$\Theta(Z,N) = [0, \angle ONQ] \cup [\angle ONS, 2\pi] \quad (4)$$
$$\Theta(N,k) = [0, \angle ONR] \cup [\angle ONS, 2\pi]$$

When the timer expires, the node N will determine the number of forwarding threshold value $C_{(N,k)}$ based on the total coverage angle $\Theta(N,k)$ of the node in $Y_{(M,k)}$, list the formula: $C_{(N,k)} = \psi\left(\Theta(N,k)\right)$.

B. Analysis of Algorithm

By studying the work area of the angle algorithm, it is found that when the distance between the node N and its upstream node M is equal to the radius of the communication, the coverage angle $\Theta(N,k)$ is the smallest, equal to 120^0.When the distance is close to 0, $\Theta(N,k)$ tends to be over 180^0 . When the same broadcast packets from other nodes are received, the coverage angle is highest to 360^0. As the angle is larger, the smaller the additional coverage area, the node counter forwarding threshold should be set relatively small, so $C_{(N,k)} = \psi\left(\Theta(N,k)\right)$ should be a reduced function.

After analysis, the following function is used in this paper:

$$C_{(N,k)} = C_h e^{\lambda + \omega \cdot \Theta(N,k)} \quad (5)$$

C_h is a constant, its value can be set according to the actual parameters of the situation. When $\Theta(N,k) = 2.0944$, the coverage angle $\Theta(N,k)$ is equal to 120^0, $\lambda + \omega \cdot 2.0944 = 0$. So the relationship function can be transformed into (λ is the parameter to be determined):

$$C_{(N,k)} = C_h e^{\lambda - \frac{\lambda}{2.0944} \cdot \Theta(N,k)} \quad (6)$$

As the Fig. 5 shows, for the relevant nodes that meet the condition $\forall v \in YW_{(M,k)}$, the distance between the node and the node satisfying the condition $\forall w \in Y_{(M,k)}$ is calculated. If the distance between the two points is calculated, the value is smaller than R, indicating that v is in the communication range of w Inside, $\Theta(v,k) = \Theta(v,k,T) \cup \Theta(w,v)$. Then calculate $C_{(v,k)} = \psi\left(\Theta(N,k)\right)$ to analyze the number of forwarding thresholds for node v, node M randomly generates a threshold value. If it is $C_1 < C_{(v,k)}$, it can be analyzed that node v does not carry out information forwarding. Instead, the analysis node v forwards the information.

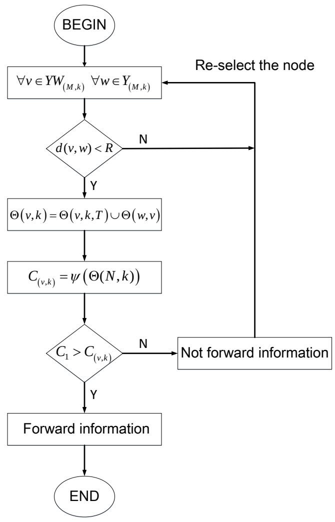

Fig. 5. The flow diagram of DCABS

IV. Performance Analysis

We have evaluated the performance of the new broadcast method using MATLAB tools and use the CSMA-based static multi-hop ad-hoc network as an experimental scenario. By using the packet communication system model as the simulation system model, so that the nodes in the network have the same function under the ideal condition, and transmit the broadcast packets according to the principle of first-in first-out (FIFO), and assume that the node model is the limited call source model. The channel model takes into account both the path loss and the shadow fading, and the wireless transmission model uses a non-persistent carrier monitoring (np-CSMA) protocol.

A. Assumptions

Our performance analysis is based on assumptions that have been widely used in the literature [13], [16].

a. As the distance increases, the wireless communication signal will be weakened. When the distance between the node and the source node exceeds the one-hop range, the node will not be able to receive the broadcast packet from the source node.

b. Between the nodes can be through the GPS and other auxiliary tools to know the current location information, and in the form of coordinates to reflect.

c. Assume that all nodes in the network are temporally synchronized and require that all nodes have comparable computing and communication capabilities. The computational power of the nodes is required to meet the needs of the multi-hop broadcasting algorithm.

d. The communication node uses an omnidirectional antenna, and the area of the wireless signal transmitted is a circular area with the same communication radius.

e. Broadcast is unreliable. The network does not use the response mechanism, the node tries to spread the broadcast message, but can't guarantee that the message can be received by all nodes.

f. Each mobile node can use the Carrier Sense Multiple Access (CSMA / CA) Protocol to share a single common channel.

B. Simulation Environment

1) Packet communication system model

As shown in Fig. 6, the system includes a source node and multiple terminal neighbor nodes. The end node has the same performance with a buffer. After the packet is generated, it is stored in the buffer and transmitted according to the principle of first-in first-out (FIFO). The capacity of the buffer can be infinite or limited. When the buffer capacity is limited, the new packet will be discarded after the packet is full, which is called "Blocking"[17]. In addition, if the terminal forwarding node is infinite, it is called the infinite call source model, and the number of nodes is limited, then it is called the limited call source model. In the theoretical analysis, it is usually assumed that the finite call source model.

2) Communication channel model

In a wireless communication system, the channel is time-varying. In the simulation process of this subject, we mainly consider the path loss caused by the distance between the access point and the terminal node, and the shadow fading due to the occlusion of the building and other obstacles.

(1) Path loss: refers to the received signal power with the source node and the distance between the neighbors increased monotonically.

(2) Shadow fading: means that the obstructions encountered by the signal during the propagation of the wireless channel will cause the signal to change randomly, resulting in a random change in the signal power at a given distance. The change in the reflector and the scatterer will also cause the received signal power Random change.

3) Based np-CSMA protocol model

Carrier monitoring protocol refers to each node in the transmission of data packets before the first channel to detect whether there are other nodes in the data transmission, if other nodes are in the data transmission, the channel state is busy, otherwise the channel state is idle. Only when the channel state is idle, the terminal only carries on the data transmission. The np-CSMA is a collision avoidance CSMA protocol. If the node detects that the channel state is idle, the data is transmitted immediately and the channel is busy. The carrier is stopped and the carrier is waiting for a period of time. Waiting time is a key factor in achieving throughput.

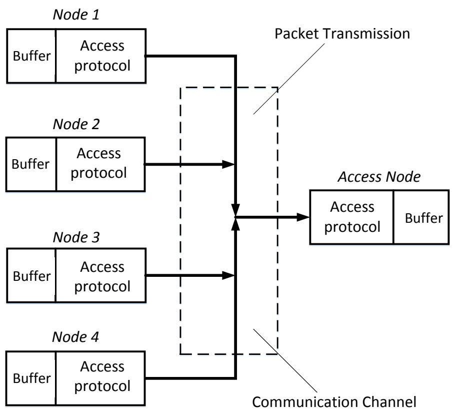

Fig. 6. The packet communication system model

In the protocol, each node is carrier monitoring, due to the existence of propagation delay, packet collision will still occur. In the actual communication system, when a node transmits data, other nodes can only detect the channel status busy after a certain delay time. If other nodes transmit data before delay, the collision is unavoidable. The propagation delay depends on the distance between the terminals. In most cases, it is assumed that the propagation delay of each node is the same and normalized with the packet transmission time.

The theoretical relationship between protocol throughput S and traffic G [13] is:

$$S = \frac{Ge^{-aG}}{G(1+2a)+e^{-aG}} \tag{7}$$

In the above relation, a is the normalized propagation delay, assuming the infinite call source model, and the channel is the ideal channel, there is no "hidden terminal" problem.

In this simulation scenario, we set the radius R of the broadcast coverage of the node to 150 m, assuming that the location coordinate of the source node in the network is $(0,0,h)$. Where h is the height of the source node from the ground, the total number of nodes in the network scenario is n (n=100, 300, 600) and the neighbor nodes are randomly distributed in the circular plane and the distance is r. At the same time, the coordinate position of the neighbor node is normalized to the integer point, and the neighbor node communicates with the source node through the wireless channel. At the MAC level, the 802.11b [18] protocol has been considered. 802.11b operates in the 2.4 GHz band designed for ISM applications.

TABLE I. SIMULATION PARAMETERS

Simulation Parameter	Value
Simulator	MATLAB R2013b
Mac type	802.11b
Protocol type	np-CSMA
Service area radius	120m
Number of neighbor nodes	100,300,600
The total number of packets successfully transmitted	1000,5000,10000
Queue type	Drop-tail Queue(FIFO)
Source node position coordinate	(0,0,5)
Minimum signal power	10dBm

We have evaluated the schemes using the following measure factors:

Business volume

In this paper, the sum of the newly generated data packets and the retransmitted packets in the unit time is defined as the traffic generated, and the traffic volume normalized by the transmission rate is *G*. Define the data transfer rate R(bps) and the number of data bits that need to be transmitted T_t, then:

$$G = \begin{cases} \frac{T_t}{R}, & n = 0 \\ 0, & n \neq 0 \end{cases} \quad (8)$$

Throughput

The throughput is defined as the total number of packets that have been successfully transferred to the access point per unit of time, and the throughput normalized at the data transfer rate is denoted by *S*. If the data transfer rate and the number of bits of information contained in each packet are denoted by R(bps) and *T*, and the number of packets successfully transmitted per unit time is n, there are:

$$S = \frac{T \cdot n}{R} \quad (9)$$

If no packet is generated, or if all the transmitted packets are discarded due to the collision, the throughput becomes the minimum value of zero. In addition, if all packets are correctly transmitted in all unit times, the throughput is 1.

Average transmission delay

The average transmission delay is the average time interval from the generation of the packet to the successful transmission to the access point, which depends on the length of the packet. By normalizing the packet length of the data, the normalized transmission delay is marked as *D*.

C. Simulation Results

1) Impact of business volume

The main performance of this experiment is to compare the three performance indexes of the actual traffic, the node information throughput and the average transmission delay in the same scene. There is also a certain relationship between the three indicators, the general situation is the throughput increased with the increase in business volume, and when the business volume is greater than a certain threshold, the throughput increases with the increase in business volume. If the traffic is greater than 1, the average transmission delay will increase as the traffic increases. So we can't just look at the merits of an indicator, we should be integrated three indicators to make decisions, we always as much as possible to improve the volume of business on the basis of the maximum possible increase in throughput and reduce the average transmission delay.

We have done a total of nine experiments, selected a set of parameters (n=300, TOTAL=5000) for analysis and interpretation, where *n* represents the number of neighbors in the network and *TOTAL* on behalf of the success of the number of data packets after the simulation can be completed.

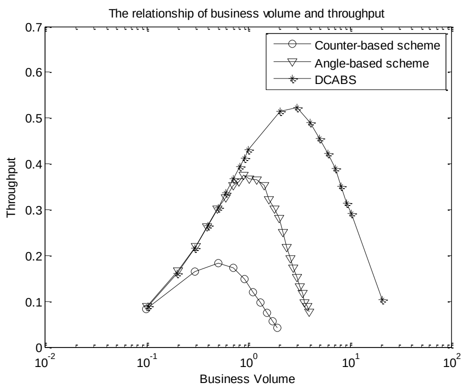

Fig. 7. The relationship of business volume and throughput about three schemes

Fig. 7 shows the relationship of business volume and throughput about three schemes. The results show that the throughput of the angle-based scheme, the counter-based algorithm and the DCABS increase with the increase of the traffic volume, when the number of neighbor nodes and the number of successfully transmitted packets are limited. When the traffic is greater than 1, the throughput of these three algorithms decreases as the amount of traffic increases, and the overall trend increases to a certain extreme value and then decreases gradually. When the traffic is less than 1, the angle-based algorithm and the DCABS algorithm are significantly larger than the communication system throughput of the counter-based algorithm, and the DCABS algorithm has a maximum throughput of more than 0.5.

In the same scene model, the communication system throughput based on DCABS algorithm is much larger than the angle algorithm and the counter algorithm. It shows that the DCABS algorithm can improve the collision or redundancy of the packet in the system, and greatly improve the communication system Work efficiency.

The results in Fig. 8 shows that as the volume of business grows, the average transmission delay of the network is increasing. To the node number is 300, successful transmission packet number is 5000 analysis, the simulation experiment, for example when the volume is less than 1, three algorithms of average latency increase slowly, which DCABS algorithm and Angle type of average transport delay than counting ware algorithm is less 300-800 packets.

If the volume of business is greater than 1, the delay of the angle-based algorithm increases dramatically as the volume of traffic increases, while the average delay of the DCABS increases slowly. When the volume of business is $10^{0.5}$, the transfer latency of the Angle algorithm reaches a maximum of 3,600 packets, while the delay of the DCABS algorithm is still less than 1000 packets.

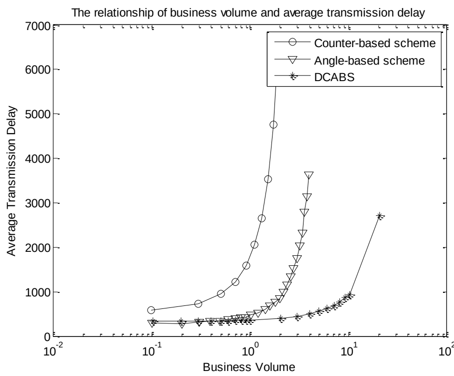

Fig. 8. The relationship of business volume and average transmission delay about three schemes

2) Impact of capture effect

In a wireless system, the power of the received packet depends on the location and channel conditions of the source node. Even if several packets collide, packets with maximum received power may be correctly received, and this effect is called "Capture Effect". We have also done a total of six experiments and selected a set of parameters (n=300, TOTAL=5000) for analysis from the existence of the capture effect level. The DCABS with capture effect is set up as "CP-DCABS".

Fig. 9 shows the relationship of business volume and throughput about four schemes. Through the observation of the relationship between throughput and traffic in the system model, it can be analyzed that the maximum throughput of simulation with capture effect is 0.6, and the maximum throughput of simulation without capture effect is 0.5. This is because when there is no capture effect, as long as the packet collision, all the packets are discarded. And when there is a capture effect, it is necessary to compare the relative size of the packet power, the maximum packet power, and the packet that is greater than the signal power threshold.

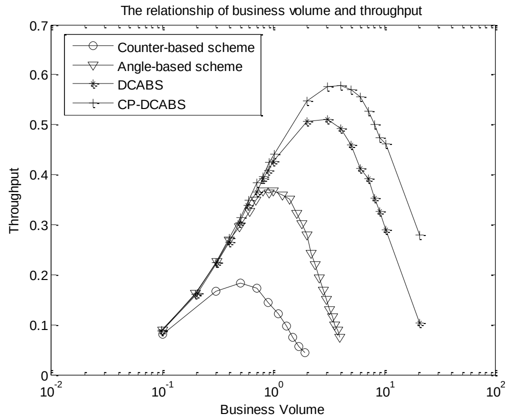

Fig. 9. The relationship of business volume and throughput about four schemes

The results in Fig. 10 show the relationship of business volume and average transmission delay about four schemes. The delay of the capture effect increases linearly with the increase in traffic, while the delay without the capture effect increases exponentially with the increase in traffic. The analysis shows that the existence of the capture effect can greatly improve the data throughput and reduce the probability of the available packet discarding, thus increasing the success rate and efficiency of the network information transmission, and it is helpful to improve the transmission quality of the network.

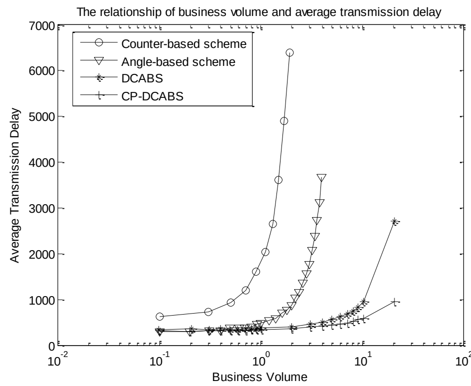

Fig. 10. The relationship of business volume and average transmission delay about four schemes.

V. Conclusion

In this paper, we summarize the basic algorithm to solve the broadcast storm problem in CSMA-based wireless network environment. Combining with the shortcomings of the existing broadcast algorithm, this paper proposes a new broadcast algorithm close to CSMA-based wireless network application scenario--Dynamic Counter Angle-based Scheme (DCABS). This new algorithm has a great improvement in average transmission delay and information throughput, reduces broadcast redundancy, increases the reachability of information, reduces the average delay of transmission of information between nodes, and compares the performance good. The simulation experiment of the new algorithm is carried out by means of MATLAB tool. The feasibility and advantage of the new algorithm are proved by comparing with the basic algorithm in the same experimental environment. Because the author's own theoretical research level is not enough depth, compared between the several algorithms only consider the actual business volume, throughput and average transmission delay of these three indicators, the analysis of the performance of the algorithm is not perfect.

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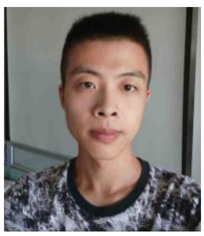

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