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RESEARCH ARTICLE

STUDY ON DOUBLE CLOCKS TWO-DIMENSIONAL PROBABILITY CSMA WITH THE FUNCTIONS OF MONITORING

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A B S T R A C T

With the rapid leap in economic and social development and information technology, wireless sensor technology has penetrated into all aspects of people's lives, the field of application relates to the military, environmental protection, industry and agriculture, and transportation management. We try to apply the theory of double clocks control to the CSMA protocols, setting the probability of sending packet and the probability of sensing channel to improve system performance. Through modeling analysis, the proposed double clocks two-dimensional probability CSMA with the function of monitoring can decrease the system idle time, making the channel resource highly use; the analytical results and simulation results show that the theoretical analysis are consistent with the simulation experiments and realize the function of monitoring.

INTRODUCTION

Wireless sensor networks, often referred to a network application system sensor composed by a large number of nodes high-density deployments. WSN is calculated machine technology, communications technology and sensor technology, conjugates; its main function is to achieve transmitting information to the terminal through a sensor communications network [1]. In recent years, with the level of economic and social development is improved continuously, at the same time combined with people's understanding for wireless perception growing, so the popularity of wireless sensor networks is increasingly strong demand, while the wireless sensor network development and construction has greatly promoted the relevant sensor and information transmission technology promoting the development of sensor technology, and promote various application areas [2]. And the further improvement and development also has a very positive meaning.

The development of wireless sensor networks to promote economic and social development and improve people the standard of living is very important, as well as the need in the wireless sensor networks. But at the application process, we should note the security of wireless sensor networks, and to take active measures for prevention [3]. In order to enhance controllability of the system, we introduce two-dimensional probability CSMA, setting the probability of sending packet and the probability of sensing channel to improve system performance [4]. The double clocks mechanism decreases the system idle time, making the channel resource highly use.Not only above, we also adopt a function of monitoring.

ACK (Acknowledgement), confirms that the characters in the data communications, send a transmission station transmitting station control character class [5]. Representation of the data has been sent to confirm acceptance correct. ACK signal is usually an ASCII character, different protocols ACK signals are not the same. When the sender receives the ACK signal, you can send the next data. If the sender does not receive a signal, then the sender may retransmit the current data packet, it may stop transmitting data [6]. In this paper, we proposed a double clocks two-dimensional probability CSMA with the functions of monitoring, set the probability of sending packet and the probability of sensing channel, improves the controllability of the system, the channel utilization, system security, and reliability of packet transmission, using the averaging cycle period conduct analytical and simulation experiment with the control strategy mentioned above. By modeling analysis, the analytical results and simulation results show that the theoretical analysis is consistent with the simulation experiments.

The model

The model of two-dimensional probability CSMA protocol with function of monitoring is showed as Fig. (1).

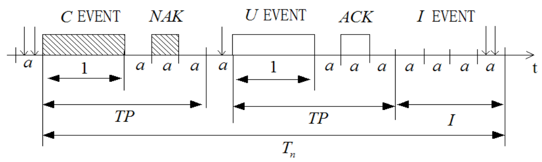

Fig 1 The model of double clocks two-dimensional probability CSMA with the functions of monitoring.

In the proposed protocol, there will be three random events

a. U events: Event that information packets are sent successfully.
b. C events: Event that information packets collide with each other (the collision appears).

c. I events: Event that there is no information packets in the channel arrive, the channel is idle.

Set the probability P_1 of sending packet and the probability P_2 of sensing channel.

Analysis Of The System Throughput

Before analyze the system performance, first do the following assumptions

a. The channel is ideal with no noise and interference;
b. The basic unit of the system control clock is a, the information packets arrived at time a will transmit at the starting time of the next slot [7];
c. The channel propagation delay is a, the packet length is unit length and is an integral multiple of a;
d. The arrival process of channel satisfy the Poisson process whose independent parameter is G [8];
e. The channel using the new protocol, the information packets need to be sent at the first slot in the transmission period can always detecting the state of the channel at last moment [9];
f. During the transmission of information packets, the phenomenon of packet collisions occur inevitably, and continues to be sent after a random time delay, it sends will not produce any adverse effects on the arrival process channel [10].

The arrival process of channel satisfies the Poisson process:

$$P(n)=\frac{(aG)^n e^{-aG}}{n!} \qquad (1)$$

In Equation (1), is the event of packets arriving during time of a.First, solve the average length of packet successfully sent in the event of U.Packet successfully sent into the following two cases: (1) If packets arrive during the last slot of idle period, namely packet arrives at the continuous clock control, and in the next slot time, no one but it adhere to send it, then it is sent successfully, the record for the event is.

The average length of U_1 is

$$E(U_1)=E(N_{U_1})\times 1=\frac{ap_1Ge^{-ap_1G}}{1-e^{-ap_1G}} \qquad (2)$$

If the packet arrives at the busy period, and the packet is the only packet adhere to sent at the current TP period, then the packet will be successfully transmitted within the next TP period, referred to as an event of.

At the transmission period, if there is no information packets to be sent, its possibility is

$$q_0=e^{-p_1p_2G(1+3a)} \qquad (3)$$

In the transmission period,if there is only one information packet to be sent, its possibility is

$$q_1=p_1p_2G(1+3a)e^{-p_1p_2G(1+3a)} \qquad (4)$$

In a cycle, the average length of information packets transmitted successfully at the is

$$E(U_2)=\frac{q_1}{q_0}=p_1p_2G(1+3a) \qquad (5)$$

Then the average length $E(U)$ is

$$E(U)=E(U_1)+E(U_2)=\frac{p_1Gae^{-p_1Ga}}{1-e^{-p_1Ga}}+p_1p_2G(1+3a) \qquad (6)$$

Secondly, the average length $E(B)$ during the busy period

$$E(B)=E(N_B)(1+3a)=\frac{1}{q_0}(1+3a)=\frac{1+3a}{e^{-p_1p_2G(1+3a)}} \qquad (7)$$

Finally, the average length $E(I)$ during the idle period

Since the number of idle slots I within the geometric distribution with the mean: $E(N)=\frac{1}{1-e^{-Gp_1a}}$, an information packet arrive in a time slot with normalized probability $p_{I1}=\frac{Gp_1ae^{-Gp_1a}}{1-e^{-Gp_1a}}$, more than an information packet arrives in a time slot with the normalized probability: $p_{I2}=\frac{1-Gp_1ae^{-Gp_1a}-e^{-Gp_1a}}{1-e^{-Gp_1a}}$.

Then we get

$$E(I)=(\frac{1}{1-e^{-Gp_1a}}-1)a+\frac{Gp_1a^2e^{-Gp_1a}}{2(1-e^{-Gp_1a})}+\frac{(1-Gp_1ae^{-Gp_1a}-e^{-Gp_1a})a}{1-e^{-Gp_1a}} \qquad (8)$$

Besides, we know that the average length $E(I')$ during the idle period under the traditional two-dimensional probability is

$$E(I')=\frac{a}{1-e^{-Gp_1a}} \qquad (9)$$

The throughput of the new protocol is:

$$S=\frac{E(U)}{E(B)+E(I)}$$
$$=[\frac{p_1Gae^{-p_1Ga}}{1-e^{-p_1Ga}}+p_1p_2G(1+3a)] \qquad (10)$$
$$/[\frac{1+3a}{e^{-p_1p_2G(1+3a)}}+(\frac{1}{1-e^{-Gp_1a}}-1)a+\frac{Gp_1a^2e^{-Gp_1a}}{2(1-e^{-Gp_1a})}$$
$$+\frac{(1-Gp_1ae^{-Gp_1a}-e^{-Gp_1a})a}{1-e^{-Gp_1a}}]$$

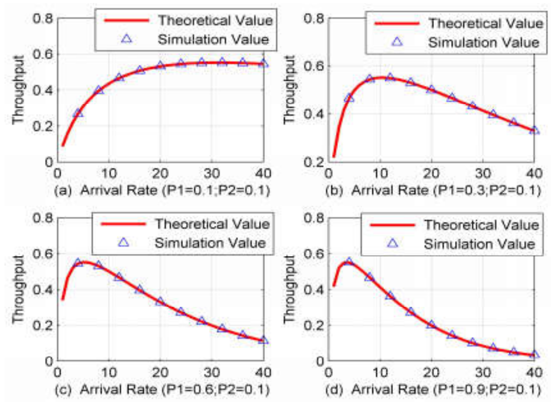

Fig 2 The throughput of the new protocol with different P1.

Simulation

From the above analysis, the expression of the system throughput under the double clocks two-dimensional probability CSMA with the functions of monitoring is got. Based on the above analysis, with the use of simulation tool:

MATLAB R2010a, the simulation results are shown as following. During the simulation, transmission delay time: $a = 0.1$.

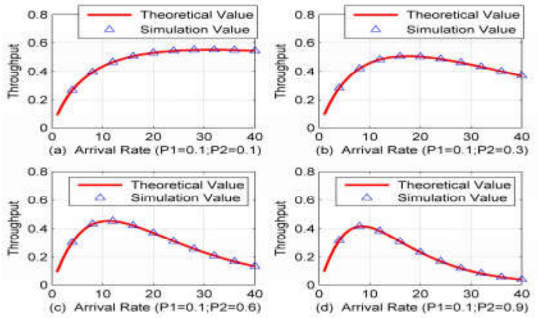

Fig 3 The throughput of the new protocol with different P2.

In Fig.(2)and Fig.(3), the simulation values of system throughput under the new protocol are consistent with the theoretical ones, verified the correctness of mathematical derivation done before.We can see that we are able to control the system throughput by change the probability of sending packet or the probability of sensing channel. Also we can change both of them at the same time too. So the new protocol can perform better than other protocols on the controllability.

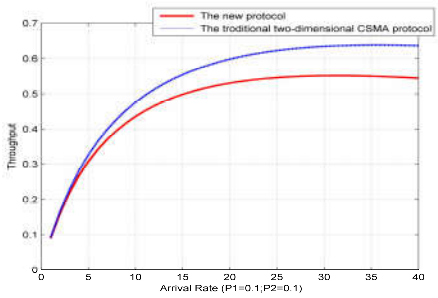

Fig 4 The throughput of the new protocol and the traditional one

From the Fig. (4), we know the system throughput under the new protocol is lower than the traditional two-dimensional probability CSMA protocol. This is because the information of ACK takes some resources of the packets transmitted. But the little system throughput we fail to gain, we realize the function of monitoring of the total system. Therefore we lose a little but get more security.

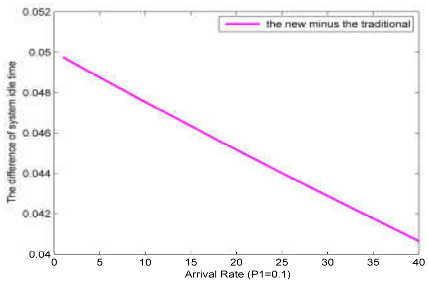

Fig 5 The difference of system idle time between the new protocol and the traditional one

From the Fig. (5), we know the system idle time under the new protocol is lower than the traditional two-dimensional probability CSMA protocol. And the channel resource is use more highly than the usually ones.

CONCLUSIONS

With the rapid leap in economic and social development and information technology, wireless sensor technology has penetrated into all aspects of people's lives, the field of application relates to the military, environmental protection, industry and agriculture, and transportation management. We try to apply the theory of double clocks control to the CSMA protocols, setting the probability of sending packet and the probability of sensing channel to improve system performance. Through modeling analysis, the proposed double clocks two-dimensional probability CSMA with the function of monitoring can decrease the system idle time, making the channel resource highly use; the analytical results and simulation results show that the theoretical analysis are consistent with the simulation experiments and realize the function of monitoring.

Acknowledgements

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