International Journal Of
Recent Scientific Research
ISSN: 0976-3031
Volume: 7(11) November -2015

THE DOUBLE CLOCKS TWO-DIMENSIONAL PROBABILITY CSMA WITH THREE-WAY HANDSHAKE MECHANISM

Chunfen Li, Shengjie Zhou, Hongwei Ding,
Zhijun Yang and Qianlin Liu

THE OFFICIAL PUBLICATION OF
INTERNATIONAL JOURNAL OF RECENT SCIENTIFIC RESEARCH (IJRSR)
http://www.recentscientific.com/ recentscientific@gmail.com

Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 6, Issue, 11, pp. 7464-7468, November, 2015

International Journal of Recent Scientific Research

ISSN: 0976-3031

RESEARCH ARTICLE

THE DOUBLE CLOCKS TWO-DIMENSIONAL PROBABILITY CSMA WITH THREE-WAY HANDSHAKE MECHANISM

Chunfen Li, Shengjie Zhou, Hongwei Ding*, Zhijun Yang and Qianlin Liu

Yunnan University, Kunming, Yunnan, 650091, P.R. China

ARTICLE INFO

Article History:

Received 15th August, 2015
Received in revised form 21st September, 2015
Accepted 06th October, 2015
Published online 28st November, 2015

Key words:

Two-dimensional probability CSMA, three-way handshake, throughput, WSN.

ABSTRACT

Through setting the probability of sending packet and the probability of sensing channel, this paper apply the theory of double clocks control to the CSMA protocols, decreasing the system idle time, making the channel resource highly use and improving the system performance. By introduction of the three-way handshake mechanism increases the reliability and stability of the system, reducing the collision possibility of the information packets to a certain extent, solves the problem of the hidden terminal and exposed terminal, improves the channel utilization. By the modeling analysis and computer simulation-MATLAB, the analytical results and simulation results show that the theoretical analysis are consistent with the simulation experiments.

INTRODUCTION

Wireless sensor networks (WSN, wireless sensor networks) is the current international concern, involving many points and hot research field [1]. It combines sensor technology, embedded computing technology, modern network and wireless communication technology and more highly cross-disciplinary knowledge, highly integrated information and distributed processing technology frontier [2]. It is possible through various integrated of micro-sensors collaborate the object or the island by monitoring, sensing and collection of environmental information in real-time. The network structure of WSN is showed in the Fig. (1). Information is transmitted wirelessly, and ad hoc multi-hop transmission network approach to the observer. Sensors, sensing target and observer composition are the three elements in the wide sensor network [3]. Wireless sensor network is a new information acquisition and processing technology [4].

The key to ensure wireless sensor network communications media (MAC) protocol in wireless sensor network protocol just bottom part, for a fair and effective sharing of communication medium between the sensor nodes have a greater impact on the performance of the sensor network, is one network protocols. Performance of wireless sensor networks such as throughput, latency performance depends entirely on the dry MAC protocol used [5]. Therefore, the design of a superior performance of MAC protocol algorithm has become a hot issue in WSN research [6].

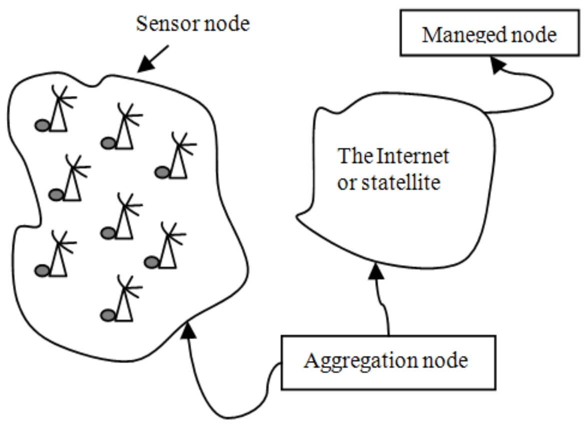

Fig (1) The network structure of WSN.

To enhance the system controllability, we introduce two-dimensional probability CSMA, setting the probability of sending packet and the probability of sensing channel to improve system performance. The double clocks mechanism decreases the system idle time, making the channel resource highly use.

Corresponding author:* **Hongwei Ding
Yunnan University, Kunming, Yunnan, 650091, P.R. China.

This paper proposed a double clocks two-dimensional probability CSMA with three-way handshake mechanism, 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. By introduction of the three-way handshake mechanism increases the reliability and stability of the system, reducing the collision possibility of the information packets to a certain extent, solves the problem of the hidden terminal and exposed terminal, improves the channel utilization. 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 three-way handshake mechanism is showed as Fig. (2).

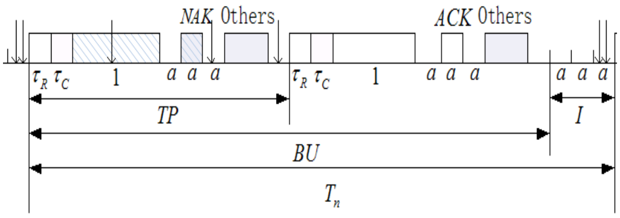

Fig (2) The model of double clocks two-dimensional probability CSMA with three-way handshake mechanism.

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.

In the model of double clocks two-dimensional probability CSMA with three-way handshake mechanism, and the total length of a transmission period is: $\frac{32}{23}(1+3a+\tau_R+\tau_C)$, where the total length of the data field is: $(1+3a+\tau_R+\tau_C)$, the total length of other field is: $\frac{9}{23}(1+3a+\tau_R+\tau_C)$.

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:

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

In Equation (1), $P(n)$ is the event of n packets arriving during time of a.

First, solve the average length $E(U)$ 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 U_1.

The average length of U_1 is:

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

(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 U_2.

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

$$q_0=e^{-p_1p_2G\frac{32}{23}(1+3a+\tau_R+\tau_C)} \tag{3}$$

In the transmission period $\frac{32}{23}(1+3a+\tau_R+\tau_C)$, if there is only one information packet to be sent, its possibility is:

$$q_1=p_1p_2G\frac{32}{23}(1+3a+\tau_R+\tau_C)\ e^{-p_1p_2G\frac{32}{23}(1+3a+\tau_R+\tau_C)} \tag{4}$$

In a cycle, the average length of information packets transmitted successfully at the U_2 is:

$$E(U_2)=\frac{q_1}{q_0}=p_1p_2G\frac{32}{23}(1+3a+\tau_R+\tau_C) \tag{5}$$

Then the average length $E(U)$ is:

$$E(U)=E(U_1)+E(U_2)=\frac{p_1Gae^{-p_1Ga}}{1-e^{-p_1Ga}}+p_1p_2G\frac{32}{23}(1+3a+\tau_R+\tau_C) \tag{6}$$

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

$$\begin{aligned}E(B)&=E(N_B)\times\frac{32}{23}(1+3a+\tau_R+\tau_C)\\&=\frac{1}{q_0}\times\frac{32}{23}(1+3a+\tau_R+\tau_C)\\&=\frac{\frac{32}{23}(1+3a+\tau_R+\tau_C)}{e^{-p_1p_2G\frac{32}{23}(1+3a+\tau_R+\tau_C)}}\end{aligned} \tag{7}$$

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: $p_{I1}=\dfrac{Gp_1ae^{-Gp_1a}}{1-e^{-Gp_1a}}$, more than an information packet arrives in a time slot with the normalized probability: $p_{I2}=\dfrac{1-Gp_1ae^{-Gp_1a}-e^{-Gp_1a}}{1-e^{-Gp_1a}}$.

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:

$$\begin{aligned}S&=\frac{E(U)}{E(B)+E(I)}\\&=[\frac{p_1Gae^{-p_1Ga}}{1-e^{-p_1Ga}}+p_1p_2G\frac{32}{23}(1+3a+\tau_R+\tau_C)]\\&/[\frac{\frac{32}{23}(1+3a+\tau_R+\tau_C)}{e^{-p_1p_2G\frac{32}{23}(1+3a+\tau_R+\tau_C)}}+(\frac{1}{1-e^{-Gp_1a}}-1)a+\frac{Gp_1a^2e^{-Gp_1a}}{2(1-e^{-G_1p_1a})}\\&+\frac{(1-Gp_1ae^{-Gp_1a}-e^{-Gp_1a})a}{1-e^{-Gp_1a}}]\end{aligned}$$

(10)

Simulation

From the above analysis, the expression of the system throughput under the double clocks two-dimensional probability CSMA with three-way handshake mechanism 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: $a=0.1$, $\tau_R=\tau_C=0.1$.

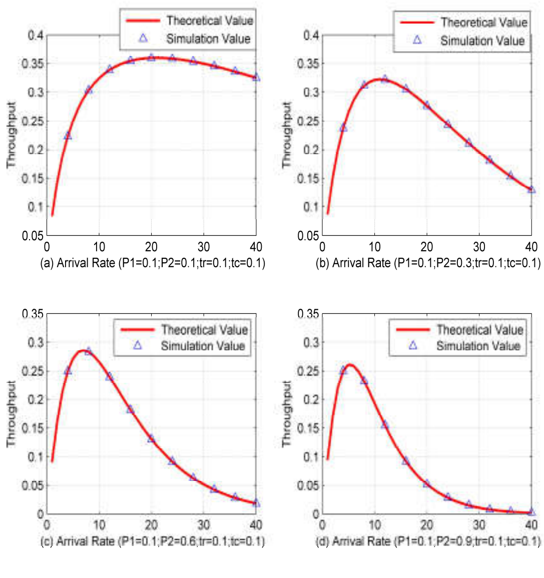

Fig (3) The throughput of the new protocol with different P1.

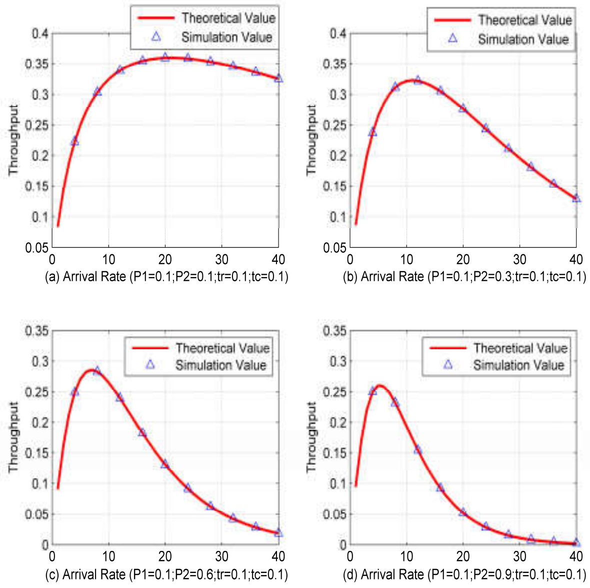

Fig (4) The throughput of the new protocol with different P2.

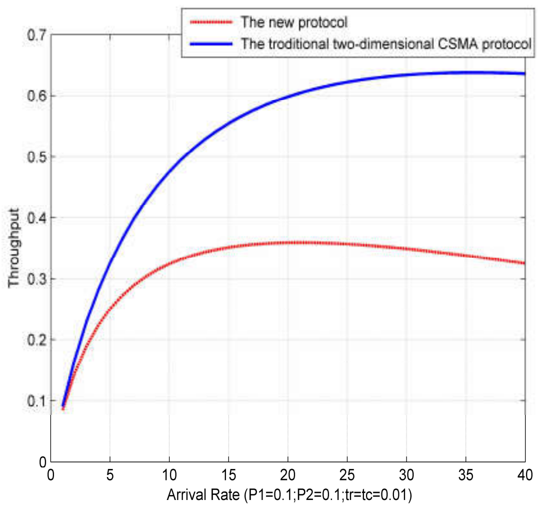

Fig (5) The throughput of the new protocol and the traditional one.

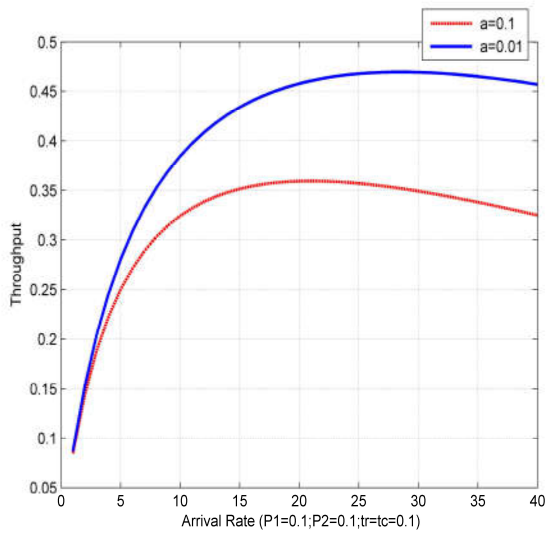

Fig (6) The throughput of the new protocol with different a.

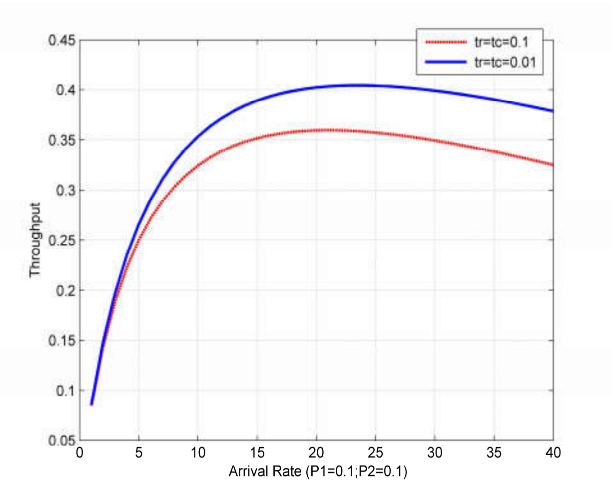

Fig (7) The throughput of the new protocol with different tr,tc.

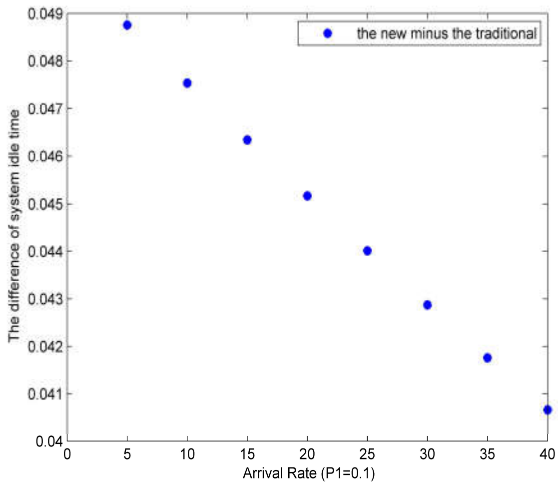

Fig (8) The difference of system idle time between the new protocol and the traditional one.

From the above MATLAB simulation can be found, the double clocks two-dimensional probability CSMA with three-way handshake mechanism has the following characteristics: From Fig. (3) to Fig. (4), 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. Through the Fig. (5) to Fig. (7), 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 RTS-CTS takes some resources of the packets transmitted. But the little system throughput we fail to gain, we realize three-way handshake mechanism of the total system. Therefore we lose a little but get more security. On the surface, the smaller the delay a, the greater system throughput, but in actual communication system, the larger the throughput is going to pay a higher price. The smaller the τ_R, τ_C parameter, the greater the system through put. This is because when the frame length of inquire-answering signal reduced, the effective data contained in a data frame will be more, the greater the throughput of the system.

In the Fig. (8), 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

By setting the probability of sending packet and the probability of sensing channel, this paper apply the theory of double clocks control to the CSMA protocols, decreasing the system idle time, making the channel resource highly use and improving the system performance. By the introduction of the three-way handshake mechanism increases the reliability and stability of the system, reducing the collision possibility of the information packets to a certain extent, solves the problem of the hidden terminal and exposed terminal, improves the channel utilization. By the modeling analysis and computer simulation-MATLAB, the analytical results and simulation results show that the theoretical analysis are consistent with the simulation experiments. At last, the computer simulation experiments show that the choice of detecting probability, listening probability and system delay has a great influence on the system throughput, so, no matter what the values are necessary to the actual system as a precondition to considering the realized possibility, the costs and gains of actual system.

Acknowledgements

This work was supported by the National Natural Science Foundation of China (61461053, 61461054, 61072079); Natural Science Foundation of Yunnan Province (2010CD023); The Financial Support of Yunnan University (No.XT412004).

References

1. Zhao Dongfeng. Study on A New Method for Continuous-time Systems of Random Access Channel [J]. Journal of Electronics, 1999, 21(1): 37-41.
2. Hongwei Ding, Yingying Guo, Yifan Zhao, Shengjie Zhou, and Qianlin Liu. Research on the Multi-Channel Probability Detection CSMA Protocol with Sensor Monitoring Function. Sensor Lett. 13, 143-146 (2015).
3. Shengjie Zhou et al., Research on the Discrete time Three-Dimensional Probability Csma Protocol In ad-hoc Network. International Journal of Recent Scientific Research Vol. 6, Issue, 5, pp.4257-4262, June, 2015.
4. Zhao Dongfeng, Li Bihai, Zheng Sumin. Study on a New Method for the Slotted Access Channel [J]. Journal of Electronics, 1997, 19(6):814-819.
5. Yi Shang, Hongchi Shi. Flexible Energy Efficient Density Control on Wireless Sensor Networks[J]. International Journal of Distributed Sensor Networks, 2007, 3(1): 101-120.
6. Liu Binbin. The Analysis of Multi-channel Random Multiple Access Wireless Communication Network Protocol based on Probability Detection [D]. Kunming: Yunnan University, 2006:55-59.
7. Ma Zuchang. Sun Yining and Mei Tao, "Survey on Wireless Sensor Network"[J], Journal of China Institute of Communications,Vol.25, pp.114-124, No.4,2004.

8. Huang Jiancheng. Xie Hai and Xu Bingzheng, “Random Prediction Tree Protocol Decomposing Collision Packets”[J], Journal of China Institute of Communications, Vol.3, pp.21,1983.
9. Zhao Dongfeng, “Study on the Average Cycle Method for Slotted Multiple-Access Communications”[J], Journal of China Institute of Communications,Vol.20, pp.80-85, No.8,1999.
10. Zhao Dongfeng, “Study on A New Method for the Slotted Access Channel”[J], Journal of Electronics,Vol.19, pp.814-819, No.6,1997

How to cite this article:
Hongwei Ding., The Double Clocks Two-Dimensional Probability Csma With Three-Way Handshake Mechanism. *International Journal of Recent Scientific Research Vol. 6, Issue, 11, pp. 7464-7468, November, 2015*

****

ISSN 0976-3031