The Study of the Masked Node Problem in Wireless Networks

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ABSTRACT

The carrier sense multiple access/collision avoidance (CSMA/CA) mechanism defined in IEEE 802.11 standard has widely adopted to become the medium access control protocol in most wireless ad hoc networks. Several research studies on the issues of CSMA/CA protocol often refer to the hidden node and the exposed node problems which characterize the network performance. The Request-to-Send/Clear-to-Send (RTS/CTS) exchange in IEEE 802.11 solves the hidden node problem, and also reduces the possibility of collision and interference. But this handshaking scheme will give rise to the exposed node problem occurred in the network, and then it severely degrades the network utilization and effectiveness. Since the exposed node may collide with its neighbors in data transmission when it is unable to distinguish the controlling frames, this may result in the neighboring nodes to interpret the received data frames correctly. In the thesis, the exposed node which is unable to distinguish the control frames is named as a masked node. A data frame collides with a control frame from a masked node leading to wasteful data retransmission. Several related works have previously proposed the solutions to the exposed node problem, but they also point out even in a good network environment with less interference. The masked node problem would still happen. In the thesis, we investigate how to distinguish a masked node from others, and propose a framework of medium access control in order to avoid the data frame collisions caused by the masked node. We evaluate the masked node problem to the impact on the network performance including the data throughput, the data collision ratio, and -viiithe average data transmission delay of the network. We also present experimental results that suggest our approach is able to improve the masked node problem

Keywords : Wireless ad hoc network， Collision， Exposed Node，Hidden Node，Masked Node

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REFERENCES

[1]“ IEEE 802.11, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, ” IEEE 802.11 Std, Aug 1999 [2] Raphael Rom and Moshe Sidi, “ Multiple Access Protocols: Performance and Analysis, ” Springer Verlag, 1990.

[3] Leonard Kleinrock and Fouad A. Tobagi, “ Packet switching in radio channels: Part 1-Carrier Sense Multiple-Access modes and their throughput-delay characteristics, ” IEEE Transactions on Communications, vol. COM-23, no. 12, pp.1400 – 1416, 1975.

[4] C.Ware, T.Wysocki, and J.F.Chicharo, “ On the Hidden Terminal Jamming Problem in IEEE 802.11 Mobile Ad Hoc Networks, ” IEEE International Conference on Communications, no. 1,pp. 261-265, June 2001.

[5] Sumit Khurana, Anurag Kahol, Anura P. Jayasumana, “ Effect of Hidden Terminals on the Performance of IEEE 802.11 MAC Protocol, ” LCN, pp.12-20, 1998 [6] V. Bharghavan, A. Demers, S. Shenker, and L. Zhang, “ MACAW: A media access protocol for wireless LAN ’ s, ” Proc. ACM SIGCOMM ’ 94, pp. 212-225, 1994 [7] C.L. Fullmer and J.J. Garcia-Luna-Aceves, “ Solutions to Hidden Terminal Problems in Wireless Networks, ” SIGCOMM -48- 97, pp. 39 – 49, Sept. 1997.

[8] F.A. Tobagi and L. Kleinrock, “ Packet switching in radio channels: Part II – The hidden terminal problem in carrier sense multiple-access and the busy-tone solution, ” IEEE Trans. Commun., vol. COM-23, pp. 1417-1433, Dec. 1975.

[9] Z.J. Haas and J. Deng, " Dual Busy Tone Multiple Access (DBTMA) – A Multiple Access Control for Ad Hoc Networks, " IEEE Transactions on Communications, vol. 50, no. 6, pp. 975-985, June 2002.
[10] J. Deng and Z.J. Haas, " Dual Busy Tone Multiple Access (DBTMA): A New Medium Access Control for Packet Radio Networks, " Proc. IEEE ICUPC ' 98, vol.2, pp.973-977, Oct. 1998.
[11] Zuyuan Fang, Brahim Bensaou, and Yu Wang, " Performance Evaluation of a Fair Backoff Algorithm for IEEE 802.11 DFWMAC, " ACM MobiHoc , pp.48-57,2002 [12] H. Zhai, J. Wang, X. Chen, and Y. Fang, " Medium access control in mobile ad hoc networks: challenges and solutions, " accepted for publication in Journal of Wireless Communications and Mobile Computing, special issue on Ad Hoc Wireless Networks, Sept. 2004.
[13] C G Ware, J Judge, J F Chicharo, and E Dutkiewicz, " Unfairness and capture behavior in 802.11 ad hoc networks, " IEEE International Conference on Communications, volume 1, -49- New Orleans, pp.159-163, 2000 [14] D. Shukla, L. Chandran-Wadia and S. Iyer, " Mitigating the Exposed Node Problem in IEEE 802.11 Ad Hoc Networks, " Indian Institute of Technology Bombay, 2003.
[15] Masked Node, http://nislab.bu.edu/nislab/education/sc441/ two/Maske d.html [16] Saikat Ray, Jeffrey B. Carruthers, and David Starobinski, " Evaluation of the masked node problem in ad-hoc wireless LANs, " accepted for publication in the IEEE transactions on Mobile Computing.