IEEE 802.11
Wireless Access Methods and Physical Layer Specifications

Title: Performance of Nonpersistent CSMA with Cell Interference and Imperfect Sensing

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Abstract

We analyze the nonpersistent CSMA with imperfect sensing (thus hidden terminals) and overlapping cell coverage in infrastructure based wireless LANs. The results which have been justified by simulations show that CSMA deliver much lower throughput (unstable peak value) than that known for traditional analysis.

Introduction

CSMA (carrier sense multiple access) has attracted a lot of attention in choosing an MAC of IEEE 802.11. One critical concern comes from changeable fading channels while wireless LANs have to live on which may cause imperfect sensing (and thus hidden terminals). Glisic showed the performance degradation for 1-persistent CSMA while no results regarding nonpersistent CSMA which may be most suitable for wireless networks. Another dimension of the problem comes from the spatial domain consideration. As infrastrucutred wireless LANs typically to use overlapping cell coverage to support seamingless services, it can cause further degradation due to interference from other cells. In this article, we put these two new concerns of nonpersistent CSMA together to analyze its performance. The results are also justified by simulations. Since the whole analysis is too complicated to present in a few pages, interested readers may ask for a copy of [1].

Main Results

We summarize the main results as follows. To model the dynamics of wireless network, we use a stochastic approach. Consider a two-cell structure, each mobile node has proabbility of p to be in the joint region (overlapping coverage of two base stations). q is the probability that transmission in another cell can be sensed in a cell. Ph is the probability that another node in a cell can become a hidden terminal for a ready node (having packet to transmit). Please note that all these proabilities can be calculated once a system plan is set up and the fading statisitics are avialable. Compared peak throughput (ignoring stability) of traditional analysis, we can easily observe significant performance degradation. However, the cell interference has limited impacts on CSMA while S-ALOHA suffers a lot [2].

References

[1] K.C. Chen, W.L. Huang, "Nonpersistent CSMA with Hidden Terminals and Cell Interference in Multicell Wireless Networks", submitted for publications.

[2] C.Y. Ko, K.C. Chen, C.C. Lu, "Performance of Slotted ALOHA in Multicell Overlapping Networks", *Proc. IEEE PIMRC, 1992.*

Graph 1: Throughput, S vs Normalized Traffic Load, G

Legend:
- —> p=0.0
- —> p=0.1
- —> p=0.2
- —> p=0.3

q=0.0
a=0.01
ph=0.1

Graph 2: Throughput, S vs Normalized Traffic Load, G

Legend:
- —> q=0.0
- —> q=0.05
- —> q=0.1
- —> q=0.2

p=0.1
a=0.01
ph=0.1