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# Capacity analysis for cognitive heterogeneous networks with ideal/non-ideal sensing

**Key words:** Cognitive heterogeneous networks, Markov chain, stochastic geometry, Homogeneous Poisson point process (HPPP)

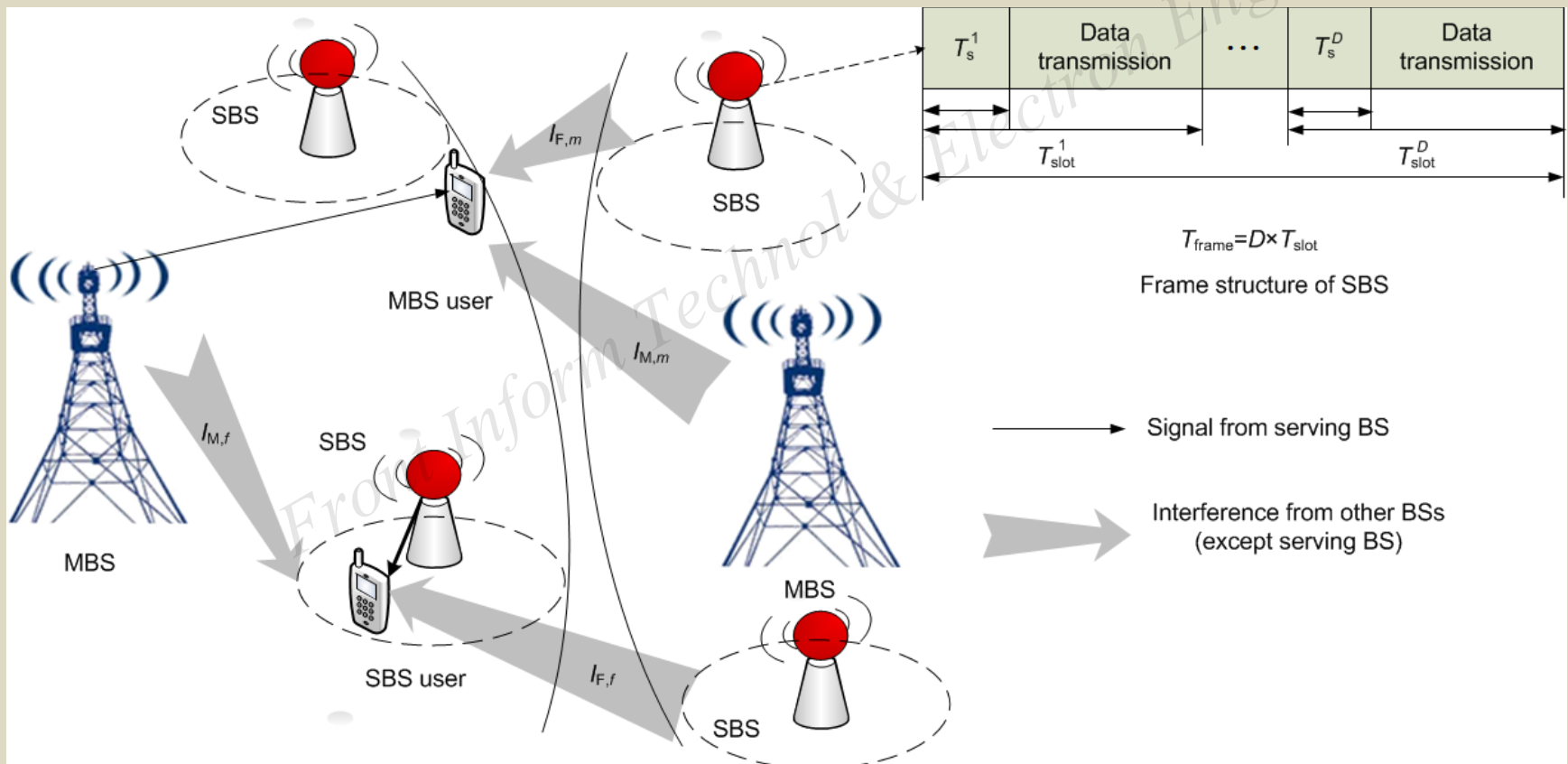
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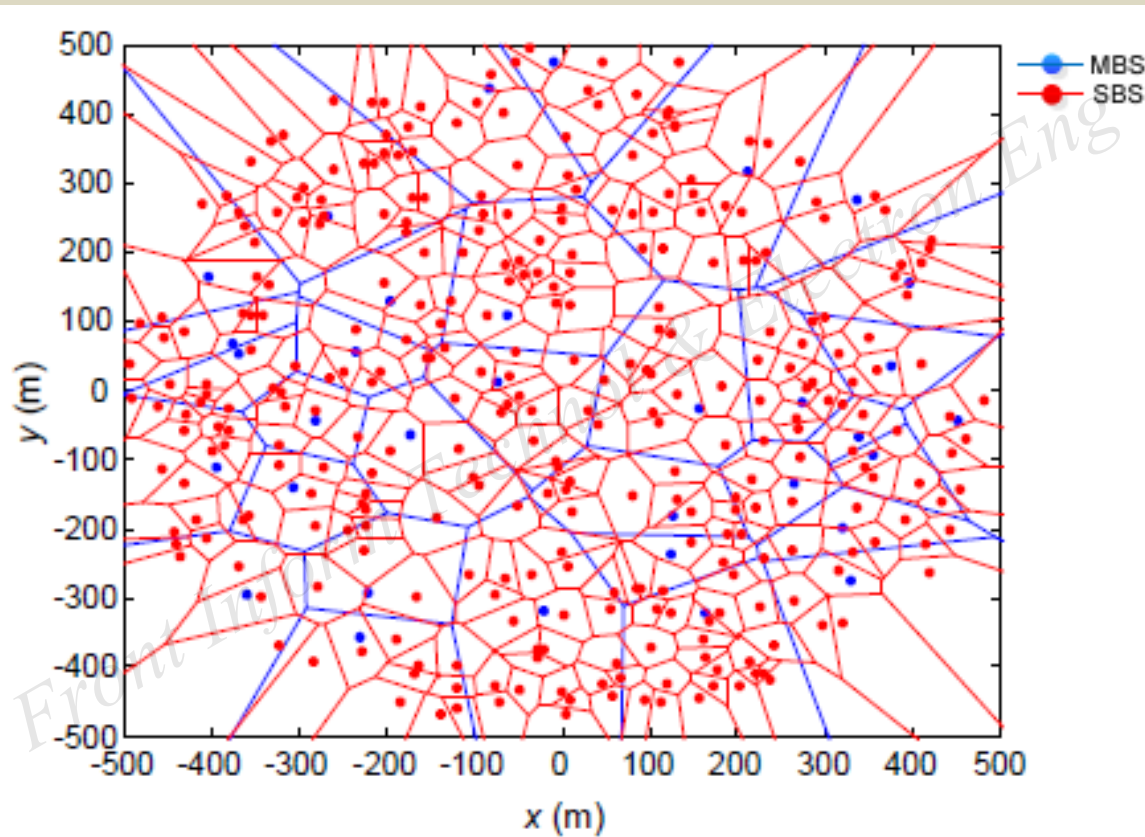
# Introduction

- Cognitive radio brings tremendous spectrum usage, which is able to solve the spectrum usage and interference management.
- There are rare ones that can provide the closed-form network capacity expression for cognitive heterogeneous networks (CHNs) because of the interference and complicated network association, especially when spectrum mobility is involved in the performance analysis.
- A closed-form expression for the capacity of CHNs is proposed based on the SG theory.

# Illustration of a two-tier heterogeneous network

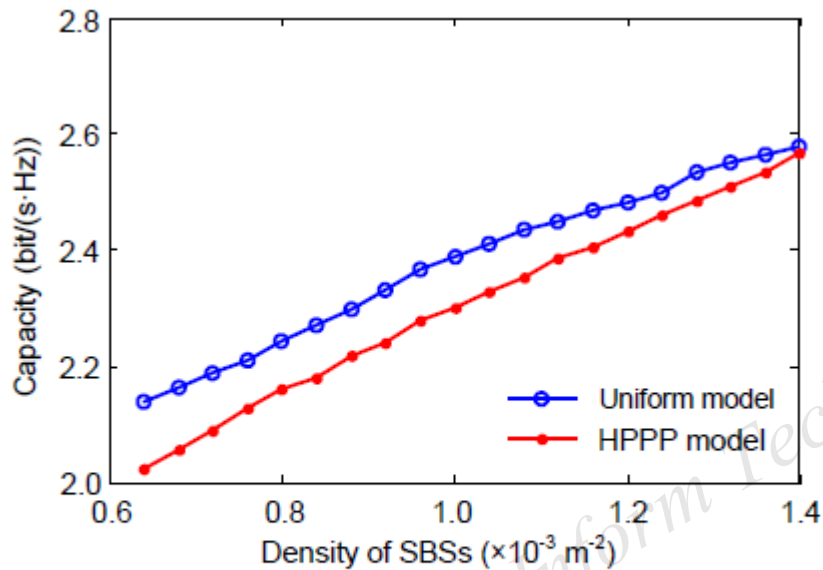


# Network model

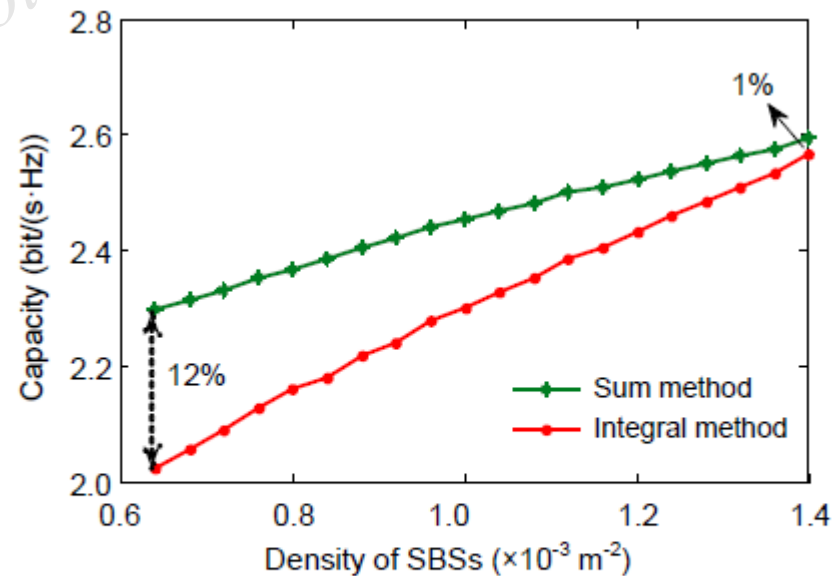


**Fig. 4** Two-tier heterogeneous network ( $\lambda_M=0.00004 \text{ m}^{-2}$ ,  $\lambda_F=0.0008 \text{ m}^{-2}$ ,  $R=500 \text{ m}$ )

# Capacity comparison of the proposed method



**Fig. 5** Capacity comparison between the uniform model and HPPP model by integral method ( $\lambda_M=0.00004 \text{ m}^{-2}$ ,  $\lambda_F=0.0008 \text{ m}^{-2}$ ,  $R=500 \text{ m}$ )



**Fig. 6** Comparison between integral method and sum method in HPPP model ( $\lambda_M=0.00004 \text{ m}^{-2}$ ,  $\lambda_F=0.0008 \text{ m}^{-2}$ ,  $R=500 \text{ m}$ )

# Effect of the number of MBS users

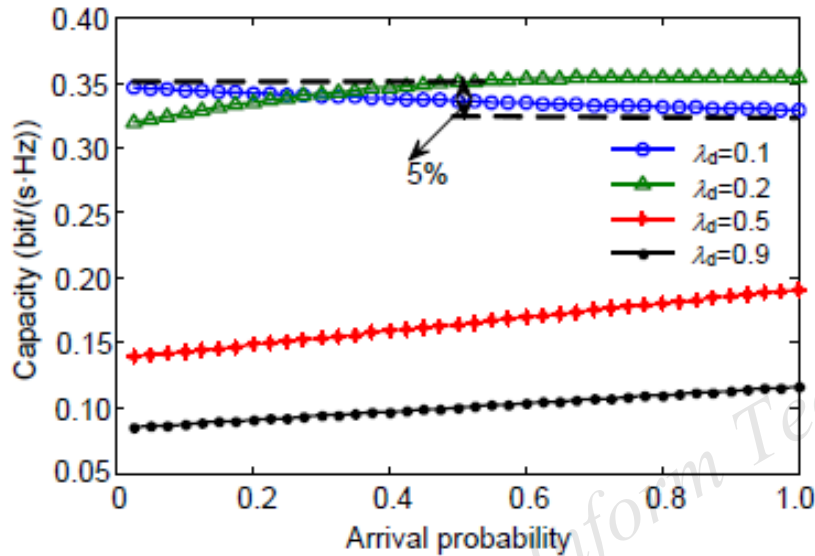


Fig. 7 Capacities under different arrival probabilities ( $p_{md}=0.01, p_{fa}=0.73$ )

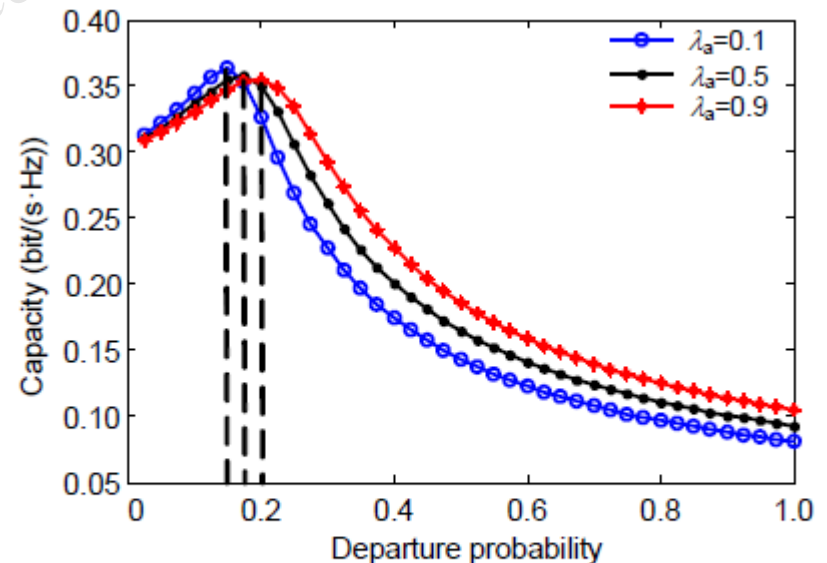


Fig. 8 Capacities under different departure probabilities ( $p_{md}=0.01, p_{fa}=0.73$ )

# Effect of sensing errors

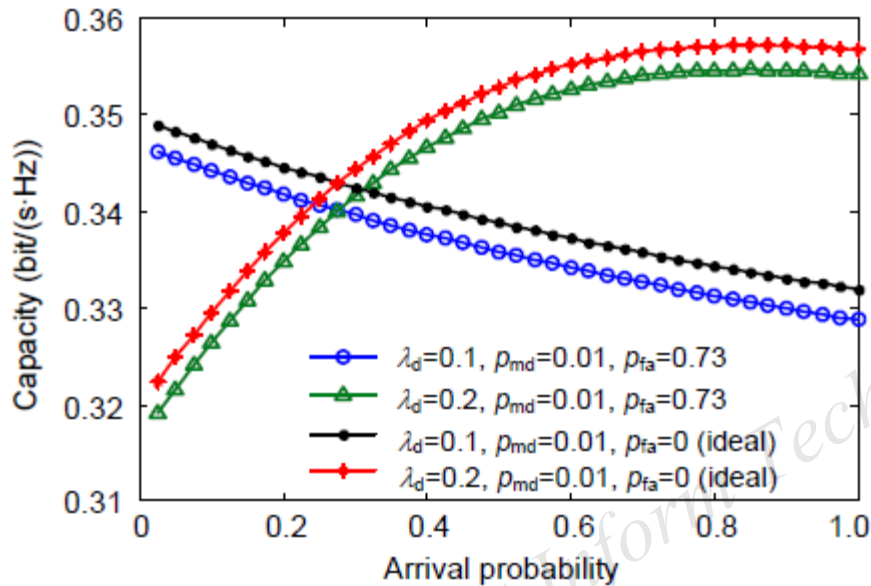


Fig. 11 Capacities under different arrival probabilities for ideal and non-ideal cases

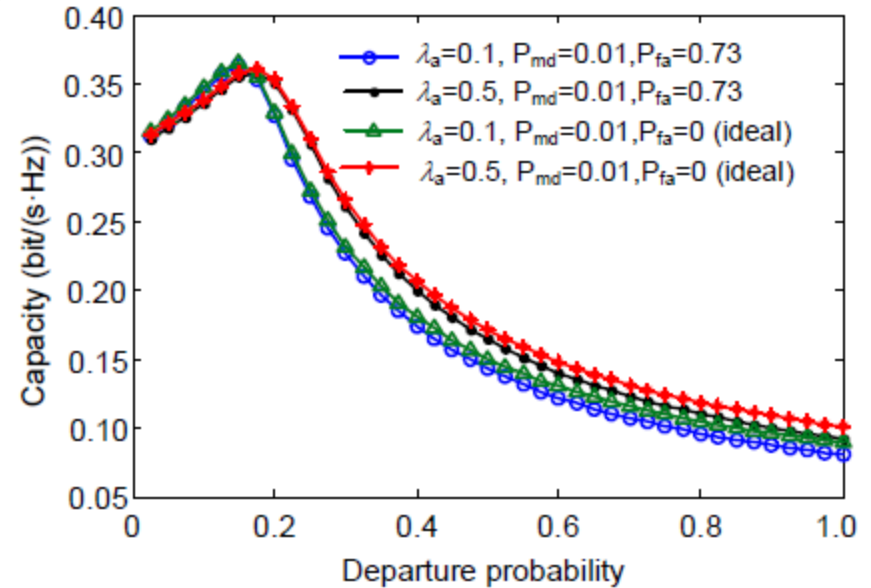


Fig. 12 Capacities under different departure probabilities for ideal and non-ideal cases

# Conclusions

- Based on the HPPP network model, the proposed method turns out to be a simple and efficient way to calculate capacity in CHNs.
- When analyzing the effect of arrival and departure probabilities on CHN capacity, it has been shown that there is an optimal DP for each AP.
- Comparison has been made between the capacities of ideal and non-ideal cases, and the results verify that the non-ideal case has a higher capacity.