Introduction to Wireless and Mobile Networking

Midterm Exam 2024/10/29

Exam Time: 14:20~15:20, 可以帶 1 張 A4 大小的筆記 (one A4 cheat sheet)

Total 100 points

I. Physical Layer [18 %]

(a) Write down Shannon capacity. Clearly define the mathematical symbols in the Shannon capacity formula [4%]

(b)If you are designing the next-generation wireless system, describe two methods that improve capacity. Explain why the proposed method improves capacity based on the Shannon capacity formula [8%]

(c) Explain inter-symbol-interference. In what type of radio propagation environment will inter-symbol interference be more severe? [6%]

II. Cellular System and Radio Propagation [20%]

(a) Consider a cellular system with reuse factor =3. Calculate the worst case downlink SIR in a cell. [8%]

(b) Explain how the path-loss exponent affects the level of interference in a cellular system. Compare two cases where path-loss exponent n= 2 and n= 4. If you would like to guarantee the performance of the worst-case downlink SIR in a cell, how does the path-loss exponent affect your cell planning and the choice of reuse factor? Why? [6%]

(c) Similar to the above question, explain how the standard deviation of log-normal shadow fading affect the performance of the worst-case downlink SIR. Compare two cases where shadowing standard deviation σ=4dB and σ=8dB. If you would like to guarantee the performance of the worst-case SIR in a cell, how does σ affect your cell planning and the choice of reuse factor? Why? [6%]

III. RTS/CTS [18%]

(a) Describe hidden node problem. How will you solve the problem? [6%]

(b) Compare the differences between RTS/CTS mechanisms in MACA and IEEE 802.11 [6%]

(c) There are two deployment scenarios (1) 200 Wi-Fi users in EE-2 Building (2) 20 Wi-Fi users in EE-2 Building. In which scenario will you use RTS/CTS? Why? [6%]

IV Wi-Fi [24%]

(a) Compare the long preamble PHY and short-preamble PHY in 802.11. What's the advantage of long-preamble design? What's the disadvantage? [6%]

(b) Describe how beacon works in 802.11. Give two examples on how beacons are used in 802.11 protocol operations [6%]

(c) How will you save power in 802.11? Explain the performance tradeoffs between power efficiency and delay? [6%]

(d) Describe how multi-user data transmission in 802.11 works. How do you ensure reliable transmission with acknowledgement mechanism in 802.11 multi-user data transmission. [6%]

V Wireless System Design [20%]

(a) What might be the challenges in designing high-speed-rail communications? Describe one challenge in Physical Layer and one challenge in MAC layer. Provide one design solution in Physical Layer and one solution in MAC layer [8%]

(b) What is near-far effect? How do you resolve it? [6%]

(c) In 6G system, user traffic is bursty and highly dynamic. In which traffic scenario, FDMA/TDD works better? In which scenario, TDMA/FDD works better? Why? [6%]