

# 國立臺北科技大學

## 九十七學年第二學期電機系博士班資格考試

### 網際網路工程試題(公告用)

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#### 注意事項：

1. 本試題共【7】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。
4. 考試時間：二小時。

1. (15 pts) Suppose an 802.11b station is configured to always reserve the channel with the RTS/CTS sequence. Suppose this station suddenly wants to transmit 1000 bytes of data, and all other stations are idle at this time. As a function of SIFS and DIFS, and ignoring propagation delay and assuming no bit errors, calculate the time required to transmit the frame and receive the acknowledgment.
2. (10 pts) What are three approaches that can be taken to avoid having a single wireless link degrade the performance of an end-to-end transport-layer TCP connection?
3. In this problem we explore designing a hierarchical overlay that has ordinary peers, super peers, and super-duper peers.
  - (a) (7 pts) Suppose each super-duper peer is roughly responsible for 200 super peers, and each super peer is roughly responsible for 200 ordinary peers. How many super-duper peers would be necessary for a network of four million peers?
  - (b) (8 pts) What information might each super peer store? What information might each super-duper peer store? How might searches be performed in such a three-tier design?

4. Suppose two nodes, A and B, are attached to opposite ends of a 900 m cable, and that they each have one frame of 1000 bits (including all headers and preambles) to send to each other. Both nodes attempt to transmit at time  $t=0$ . Suppose there are four repeaters between A and B, each inserting a 20-bit delay. Assume the transmission rate is 10 Mbps, and CSMA/CD with backoff intervals of multiples of 512 bits is used. After the first collision, A draws  $K=0$  and B draws  $K=1$  in the exponential backoff protocol. Ignore the jam signal and the 96-bit time delay.
  - (a) (10 pts) What is the one-way propagation delay (including repeater delays) between A and B in seconds? Assume that the signal propagation speed is  $2 \cdot 10^8$  m/sec.
  - (b) (10 pts) At what time (in seconds) is A's packet completely delivered at B?
  
5. Consider sending a large file from a host to another over a TCP connection that has no loss.
  - (a) (10 pts) Suppose TCP uses AIMD for its congestion control without slow start. Assuming CongWin increases by 1 MSS every time a batch of ACKs is received and assuming approximately constant round-trip times, how long does it take for CongWin to increase from 1 MSS to 6 MSS (assuming no loss events)?
  - (b) (10 pts) What is the average throughput (in terms of MSS and RTT) for this connection up through time = 5 RTT ?
  
6. (10 pts) Compare and contrast link-state and distance-vector routing algorithms.
  
7. (10 pts) Suppose a peer with username Arnold discovers through querying that a peer with username Bernard has a file it wants to download. Also suppose that Bernard and Arnold are both behind a NAT. Try to devise a technique that will allow Arnold to establish a TCP connection with Bernard without application-specific NAT configuration. If you have difficulty devising such a technique, discuss why.