國 立 臺 北 科 技 大 學

九十九學年第二學期電機系博士班資格考試

電腦網路理論 試題

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注意事項：

1. 本試題共【10】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.(10 points) (a) What is the channel capacity for a teleprinter channel with a 300-Hz bandwidth and a signal-to-noise ratio of 3 dB, where the noise is white thermal noise?
(b) A digital signaling system is required to operate at 9600 bps. If a signal element encodes a 4-bit word, what is the minimum required bandwidth of the channel?

2. (10 points) (a) A telephone line is known to have a loss of 20 dB. The input signal power is measured as 0.5 W, and the output noise level is measured as Using this information, calculate the output signal-to-noise ratio in dB.
(b) Given a 100-Watt power source, what is the maximum allowable length for the optical fiber operating at its optimal frequency if a signal of 1 Watt is to be received?

3. (10 points) Consider four different cellular systems that share the following characteristics. The frequency bands are 825 to 845 MHz for mobile unit transmission and 870 to 890 MHz for base station transmission. A duplex circuit consists of one 30-kHz channel in each direction. The systems are distinguished by the reuse factor, which is 4, 7, 12, and 19, respectively.

(a) Suppose that in each of the systems, the cluster of cells (4, 7, 12, 19) is duplicated 16 times. Find the number of simultaneous communications that can be supported by each system.

(b) Find the number of simultaneous communications that can be supported by a single cell in each system.

(c) What is the area covered, in cells, by each system?

4. (10 points) System A consists of a single ring with 300 stations, one per repeater. System B consists of three 100-station rings linked by a bridge. If the probability of a link failure is P_l, a repeater failure is P_r, and a bridge failure is P_b, derive an expression for parts (a) through (d):
(a) Probability of failure of system A
(b) Probability of complete failure of system B
(c) Probability that a particular station will find the network unavailable, for systems A and B
(d) Probability that any two stations, selected at random, will be unable to communicate, for systems A and B.

5. (10 points) The binary exponential backoff algorithm is defined by IEEE 802 as follows: The delay is an integral multiple of slot time. The number of slot times to delay before the nth retransmission attempt is chosen as a uniformly distributed random integer r in the range $0<=r<2^K$, where $K=min(n,10)$.
Slot time is, roughly, twice the round-trip propagation delay. Assume that two stations always have a frame to send. After a collision, what is the mean number of retransmission attempts before one station successfully retransmits? What is the answer if three stations always have frames to send?

6.(10 points) (a) Given a company with six individual departments and each department having ten computers or networked devices, what mask could be applied to the company network to provide the subnetting necessary to divide up the network equally?
(b) In contemporary routing and addressing, the notation commonly used is called classless interdomain routing or CIDR. With CIDR, the number of bits in the mask is indicated in the following fashion: 192.168.100.0/23. How many addresses are provided with 192.168.100.0/23?

7.(10 points) (a) When multiple equal-cost routes to a destination exist, OSPF may distribute traffic equally among the routes. This is called *load balancing*. What effect does such load balancing have on a transport layer protocol, such as TCP?
(b) Multicast applications commonly use UDP or RTP (Real-Time Transport Protocol) as their transport protocol. Multicast applications do not use TCP as its transport protocol. What's the problem with TCP?

8. (10 points) A single video source transmits 30 frames per second, each containing 2 Mbits of data. The data experiences a delay jitter of 1 s. What size of delay buffer is required at the destination to eliminate the jitter?

9. (10 points) One difficulty with the original TCP SRTT estimator is the choice of an initial value. In the absence of any special knowledge of network conditions, the typical approach is to pick an arbitrary value, such as 3 seconds, and hope that this will converge quickly to an accurate value. If this estimate is too small, TCP will perform unnecessary retransmissions. If it is too large, TCP will wait a long time before retransmitting if the first segment is lost. Also, the convergence may be slow, as this problem indicates.

(a) Choose α=0.85 and SRTT(0)=3 second, and assume all measured RTT values = 1 second and no packet loss. What is SRTT(19)?

(b) Now let SRTT(0)=1 second and assume measured RTT value = 3 second and no packet loss. What is SRTT(19)?

10. (10 points) (a) Explain the differences among HTTP proxy, gateway, and tunnel.

(b) What is the function of the cache in HTTP?