



## FORMULAE AND DATA

Shannon's Law:

$$C = H \log_2(1+S/N)$$

Nyquist's Law:

$$C = 2H \log_2 V$$

Quantization Noise:

$$\text{SNR} = 6n + a \text{ dB}$$

Ratio-to-dB conversion:

$$\text{SNR}(\text{in dB}) = 10 \log_{10} S/N$$

Fourier series representation of periodic signals:

$$g(t) = \frac{1}{2}c + \sum_{n=1}^{\infty} a_n \cos(2\pi nft) + \sum_{n=1}^{\infty} b_n \sin(2\pi nft)$$

Some selected encoding schemes:

Encoding Scheme	0	1
NRZ-L	High	Low
NRZI	No change	Invert
Manchester	high-to-low	low-to-high

The channel utilization of selected ARQ schemes:

Stop-n-wait	Sliding window (window size = W)
$U = \frac{1}{1+2a}$	$U = \frac{W}{1+2a}$

== END OF FORMULAE AND DATA ==

**INSTRUCTIONS:**

1. This test paper consists of five questions.
2. The total mark of this exam is 40%.
3. You should attempt to answer all questions.
4. Your answers should be precise and concise. No long answers are necessary. Use diagrams when needed.

**GOOD LUCK****Question 1 (10%)**

- 1-1. Given a signal  $x(t)$  where  $x(t) = 4\cos 500\pi t + 3\cos 1000\pi t + 2\cos 1500\pi t$ , what is the minimum sampling rate for this signal?
- (a) 500Hz
  - (b) 1000Hz
  - (c) 1500Hz
  - (d) 3000Hz
- 1-2. Which of the following statements is incorrect related to the Manchester encoding scheme:
- (a) It is a self-clocking scheme.
  - (b) It achieves only 50% efficient.
  - (c) The produced signals always contain a transition in the middle of a bit.
  - (d) The receiver needs to distinguish three levels.
- 1-3. Which of the following functions is not the role of the Data Link layer?
- (a) Fragmentation.
  - (b) Error detection and control.
  - (c) Medium access control.
  - (d) Signal regeneration.
- 1-4. Ethernet MAC protocol, CSMA/CD, cannot be used for wireless LANs because:
- (a) wireless channel is too noisy to detect collision.
  - (b) stations are mobile making collision detection unreliable.
  - (c) transmitted signals may be echoed back to the sender making collision detection impossible.
  - (d) The encoding scheme used in CSMA/CD is not suitable for wireless transmissions.
- 1-5. It is said that a Token Ring LAN is more suitable for real time multimedia traffic than an Ethernet LAN mainly because:
- (a) multimedia traffic is recognized and handled differently in the Token Ring MAC protocol, whereas the Ethernet protocol does not differentiate traffic.
  - (b) the performance of the Token Ring MAC protocol (close to 100% channel utilization) is far better than that in the Ethernet MAC protocol (only about 60% under most circumstances).
  - (c) the delay characteristic of a Token Ring LAN is deterministic, while an Ethernet LAN is not.
  - (d) a Token Ring LAN features a priority scheme that guarantees a QoS for the transportation of multimedia traffic, while it is not found in an Ethernet LAN.

1-6. FDDI MAC protocol has a less restricted priority scheme than the IEEE 802.5 Token Ring protocol because

- (a) FDDI is deployed in a higher data rate LAN so that a token frame transmission becomes shorter which limits the priority scheme.
- (b) FDDI implements early token release option so that a station cannot detect any possible reservation before releasing a token.
- (c) the priority scheme used in the IEEE 802.5 MAC protocol cannot be used in a network that has a large coverage such as FDDI.
- (d) the priority scheme used in the IEEE 802.5 MAC protocol cannot be implemented in fibers.

1-7. 10BASE-T is more reliable than 10BASE-5 because

- (a) 10BASE-T uses a hub that will detect a physical fault in the network.
- (b) 10BASE-T is based on star topology where the channel is separated into several individual links that will not affect each other.
- (c) 10BASE-5 uses a repeater connecting all stations. The entire network is down if the repeater is not working properly.
- (d) 10BASE-5 uses thick coaxial cable that is easier to break.

1-8. Which of the following statements is not a responsibility of bridges?

- (a) Frame format conversion if necessary.
- (b) Error correction by acknowledging sender if a corrupted frame is received.
- (c) Frame forwarding from one LAN to another in a "store-and-forward" method.
- (d) Learning the location of a computer.

1-9. The main attraction of an ATM network is that?

- (a) it is cheap to implement, even cheaper than Ethernet in most of the commonly used network configurations.
- (b) It provides a good QoS level for real-time multimedia traffic that is difficult to achieve in other networks such as Ethernet.
- (c) it can interconnect with other networks easily because it provides connectionless services.
- (d) it offers a wide range of data rates that makes it possible to be used as a LAN, a backbone network or a WAN.

1-10. Which of the following statements is false regarding the distance vector routing algorithm?

- (a) A router informs its new routing table to all other routers by broadcasting it to everyone in the network.
- (b) A router develops its routing table based on the routing tables received during message exchange with other routers.
- (c) The distance vector routing algorithm exhibits the "count-to-infinity" problem.
- (d) The distance vector routing algorithm is used in early networks such as ARPANET.

3/9/08

**Question 2: Physical Layer (5%)**

A telephone company has installed a cable for its telephone network connecting two locations. It is known that the bandwidth of the cable is 1.5MHz for each direction of transmissions with the signal to noise ratio,  $S/N = 31$ .

An 8-bit PCM system with 8kHz sampling rate is used in the telephone network for digitizing voice signals. Two channels, one in each direction of transmissions, are required for a telephone call (for a two-way conversation).

According to Shannon's Law, "at most" how many telephone calls can be carried simultaneously on the cable?

**Question 3: Data Link Layer (5% + 5%)**

3(a). Determine the check bit(s) for message 01110010 given that the CRC codes are generated by  $x^3+1$ .

3(b). Consider a communication system between two nodes using the Go-Back-N ARQ scheme. The window size is set to 7. Illustrate, with an example, that if the sequence number space is also 7 (that is: only numbers between 0 and 6 are used to label a frame), a reliable communication between two systems cannot be guaranteed.

**Question 4: Local Area Networks (5% + 5%)**

4(a). The "carrier extension" operation is introduced in the IEEE 802.3z MAC protocol allowing a shared Gigabit Ethernet LAN to cover over 20m. What problem will occur if a shared Gigabit Ethernet spans over 20m without the "carrier extension" operation? Explain how the "carrier extension" operation solves the problem.

4(b). Explain how four-way handshaking can be used to solve the Hidden/Expose station problem in an IEEE 802.11 ad hoc wireless LAN.

**Question 5: Internetworking (5%)**

Consider a network shown below. Assume that bridge labeled  $i$  carries identifier  $i$ , where  $101 \leq i \leq 107$ . The cost of each port is set to one. Which ports of each transparent bridge will be enable after all transparent bridges are activated? Indicate whether an active port is a port of a root bridge (RB), a root port (RP) or a designated port (DP). Explanation is unnecessary.

