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Department of Computer Science and Engineering

CSE 3213: Computer Networks I (Summer 2008)

Midterm

Date: June 12, 2008

Name:_____

Student number:_____

Instructions:

- Examination time: 120 minutes.
- Write your name and student number in the above provided space.
- You are not allowed to use laptop, textbook, cell phone and any kind of electronic devices during the exam **except calculator**.
- Ensure that this examination has 10 pages and 23 questions.
- Answer the questions in the provided spaces. If you run out of room for an answer, continue on the back of the page.
- Good Luck!

Part I MC (1 mark each)

1. How can you verify that two hosts are connected and communicating properly?

    a. From a third host, run the "ping" command to each of the other hosts.
    b. From one host, run the "ping" command to the other host.
    c. Run the "arp" command on both hosts.
    d. Run the "ipconfig" command on both hosts.

2. The most common way to measure latency on data networks is by calculating packet's _____

    a. round trip time
    b. bend radius
    c. modulation
    d. fault tolerance

3. Voice over Internet Protocol (VoIP) provides the capability to:

    a. Transmit voice signals over a packet switched network
    b. Convert digital data to analog and sent it on a WAN
    c. Allow two computers to transfer files over analog lines
    d. Encrypts data between two devices on a IP network

4. _____ is an application layer protocol.

    a. TCP
    b. UDP
    c. IP
    d. HTTP

5. A data packet travels from source to destination. At the destination, as the data packet moves from the lower to the upper layers, headers are _____.

    a. added
    b. removed
    c. modified
    d. none of the above

6. What is the bandwidth of a signal that ranges from 400 Hz to 4 KHz
    a. 400 Hz
    b. 360 Hz
    c. 3600 Hz
    d. 4000 Hz

7. What does it mean by the attenuation of 0 db between two points?

    a. Signal at point one is larger than signal at point two
    b. Signal at point one is equal to signal at point two
    c. Signal at point one is smaller than signal at point two
    d. Signal at point two is equal to zero

8. The first step in converting analog to digital is _____.

    a. sampling
    b. quantizing
    c. line coding
    d. modulation

9. Which of the following statements is true?

    a. Digital data can be transmitted by using analog signal
    b. Analog data can be transmitted by using digital signal
    c. The higher the SNR the better the received signal quality
    d. All of the above

10. Which of the followings does not relate to noise (transmission impairments)?
    a. Modulation
    b. Quantization
    c. Latency
    d. Electromagnetic

Part II

11. List two applications that require reliable transport and two applications that do not require reliable transport. (4marks)

Required reliability
Online bank transaction
FTP
Web page

Do not required reliability
Internet radio
DNS

12. Which OSI layer is responsible for the following? (3 marks)
    a. Determining the best path to route packets

    Network layer

    b. Providing end-to-end communications with reliable service

    Transport layer

    c. Providing node-to-node communications with reliable service

    Data link layer

13. Suppose the population of the world is 6 billion, and that there is an average of 1000 communicating devices per person. How many bits are required to assign a unique host address to each communicating device? Suppose that each device attaches to a single network and that each network on average has 10000 devices. How many bits are required to provide unique network ids to each network? (6 marks)

$\log_2 (6 \times 10^9 \times 10^3) = 42.44$
$\Rightarrow$ 43 bits are required to assign a unique host address to each communicating device.

$\log_2 ((6 \times 10^9 \times 10^3) / 10{,}000) = 29.2$
$\Rightarrow$ 30 bits are required to provide unique network ids to each network.

14. What are a physical address, a network address, and a domain name? (3 marks)

The physical address is the unique hardware address (MAC address) that identifies an interface of a machine on a physical network such as a LAN. Physical addresses are used in the data link layer.

A network address is a machine's logical address on a network. The network address is used in the network layer. IP address is a network address used in the Internet

Domain names are used to identify a host (or computer) on the Internet, since names are easier to remember than numbers (i.e. IP address). The DNS system is used to translate between domain names and IP addresses. E.g. the domain name for the network address 130.63.92.30 is www.cse.yorku.ca.

15. How long does it take to send a file of 640,000 bits from host A to host B over a circuit-switched network? (4 marks)
    - All links are 1.536 Mbps.
    - Each link uses TDM with 24 slots/sec.
    - 500 msec to establish end-to-end circuit

For a TDM link, time is divided into frames of fixed duration and each frame is divided into a fixed number of time slots. When the network establishes a connection across a link, the network dedicates one time slot in every frame to the connection. These slots are dedicated for the sole use of that connection, with a time slot available for use (in every frame) to transmit the connection's data.

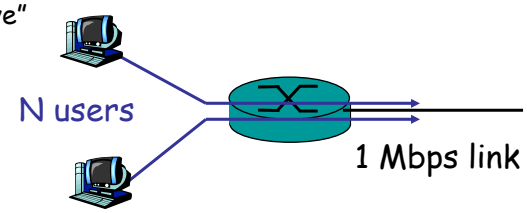
Each circuit has a transmission rate of (1.536 Mbps)/24 = 64 Kbps, so it takes (640bits)/(64 Kbps) = 10 seconds to transmit the file. To this 10 seconds we add the the circuit establishment time, giving 10.5 seconds to send the file. Note that the transmission time is independent of the number links: the transmission time would be 10 seconds if the end-to-end circuit passes through one link or one-hundred links.

16. In theory, which switching technique (circuit or packet) allows more users within a network? Explain in detail. (5 marks)

Packet switching versus circuit switching

Packet switching allows more users to use network!

- 1 Mb/s link
- each user:
  - 100 kb/s when "active"
  - active 10% of time
- *circuit-switching:*
  - 10 users
- *packet switching:*
  - 10 users or less → no problem
  - >10 users → queuing delay but still possible to support 11+ users



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17. List at least four reasons of the use of layers? (4 marks)

- Layering simplifies design, implementation, and testing by partitioning overall communications process into parts
- Protocol in each layer can be designed separately from those in other layers
- Protocol makes "calls" for services from layer below
- Layering provides flexibility for modifying and evolving protocols and services without having to change layers below
- Monolithic non-layered architectures are costly, inflexible, and soon obsolete

18. What are the network transmission impairments that degrade the quality of stream information? (3 marks)

- Delay: Is information delivered in timely fashion?
- Jitter: Is information delivered in sufficiently smooth fashion?
- Loss: Is information delivered without loss? If loss occurs, is delivered signal quality acceptable?

19. Temperature is one of the significant factors in agriculture. Monitoring temperature values can be done with the use of wireless sensor networks. If we knew that the maximum temperature variation is 3 degrees Celsius in half an hour, what would be the minimum time interval that the temperature data are recorded? *Hint: Nyquist Theorem* (7 marks)

3 degrees per half an hour → 6 degrees/hour → the Nyquist rate is 12 samples/hour → sampling period is 5 minutes (time interval)

20. Consider an analog repeater system in which the signal has power σ_x^2 and each stage adds noise with power σ_n^2. For simplicity assume that each repeater recovers the original signal without distortion but that the noise accumulates. Find the SNR (expression in dB) after ***n*** repeater links. (5 marks)

After n stages, the signal power is σx2and the noise power is nσn2, so the SNR is:
SNR dB = $10 \log_{10} \sigma_x^2 / n\sigma_n^2 = 10 \log_{10} \sigma_x^2 / \sigma_n^2 + 10 \log_{10} 1/n = 10 \log_{10} \sigma_x^2 / \sigma_n^2 - 10 \log_{10} n$

21. Suppose that a low-pass communications system has a 1 MHz bandwidth. What is an attainable bit rate using 8-level pulses? What is the Shannon capacity of this channel if the SNR is 20 dB? (6 marks)

Nyquist pulses can be sent over this system at a rate of 2 million pulses per second. Eight-level signalling carries 3 bits per pulse, so the bit rate is 6 Mbps.

The Shannon capacities are:
C = $1000000 \log_2 (1 + 100) = 6.6$ Mbps.

22. What is line coding and why do we need to study different line coding schemes? (4 marks)

Mapping of binary information sequence into the digital signal that enters the channel
Ex. "1" maps to +A square pulse; "0" to –A pulse

Line code selected to meet system requirements:

- Transmitted power: Power consumption = $
- Bit timing: Transitions in signal help timing recovery
- Bandwidth efficiency: Excessive transitions wastes bw
- Low frequency content: Some channels block low frequencies
- long periods of +A or of –A causes signal to "droop"
- Waveform should not have low-frequency content
- Error detection: Ability to detect errors helps
- Complexity/cost: Is code implementable in chip at high speed?

23. Encode the following bit stream using Unipolar NRZ and Polar NRZ 10011000. In general, which technique requires less average power? (6 marks)