SANTA CLARA UNIVERSITY
Department of Computer Engineering

COEN 001 Midterm Exam #2 Solution Fall 2002

Oversampling

The technique of sampling an audio signal at a rate faster than that required by the Nyquist sampling rate in order to aid in economically reproducing the original audio signal.

Sound wave

A Sound Wave is created by areas of compressed and expanded molecules propagating through the medium in which the sound is traveling.

Frequency of an audio signal

The number of oscillations of the signal per second, in hertz. It is a measurement of how rapidly the audio signal is changing.

Bandwidth

The highest frequency component in an audio signal is referred to as the bandwidth of the signal.
A measure of the amount of information contained in a signal, for a transmission channel, a measure of the amount of information which it can transmit.

Nyquist sampling rate

IN ORDER TO BE PERFECTLY REPRESENTED BY ITS SAMPLES, A SIGNAL MUST BE SAMPLED AT A SAMPLING RATE EQUAL TO AT LEAST TWICE ITS HIGHEST FREQUENCY COMPONENT.

Roaming (with respect to Cellular telephones)

It means that you are not within range of the cell system to which you subscribe.

Traditionally, when you were off the home system, there was often no way to know where the cell phone was located, and hence no way to connect an incoming call. This problem has essentially been eliminated at present, with better real- time communication of cell phone status and location among systems.

FDMA frequency division multiple access.

A technique in which each user is simply assigned an individual frequency (actually two frequencies, one for each direction of voice transmission) for the duration of a telephone call.

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TDMA. time division multiple access

A technique in which each user occupies the entire radio spectrum, but only for a brief time. After one user transmits a burst of information, that user is quiet for a time and another user transmits a burst. This continues for all the users until it is time for the first user to transmit again.
TDMA lends itself naturally to digital signal processing.

Iridium telephone system

A satellite based telephone system with 66 satellites in low earth orbit. The Iridium system went into bankruptcy and ceased operations early in 2000.

Circuit Switched Network

A network in which connections between users are set up and taken down frequently under the control of the user as opposed to being permanent.
Circuit-based networks maintain a path between the users for the duration of the session.

Packet-Based Network

Packet-based networks are those in which individually addressed packets of information are sent into a communications system, and are individually forwarded until they reach the recipient.

Ethernet

The original Ethernet was a concept of a communications scheme that can link 256 computers and other office equipment for the purposes of sharing documents and other information.
Ethernet II provides means of transmitting 10 Mbps data streams among large numbers of computers distributed over a 2.5 km (1.5 mile) diameter area.

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True/False? Sound only travels in air. (5 points)
False – Sound travels in many mediums, water, metal, air, i.e. any medium that propagates mechanical energy.

Which of the following apply to a pure sinusoidal wave of 440 Hz?
(15 points, put an 'X' in the box next to **all** that apply)

- [ ] - is a wave containing multiple frequency components
- [ ] - is easily created with a saxophone
- [X] - is a pure tone
- [ ] - has a bandwidth of 880 Hz
- [ ] - none of the above

A pure sinusoidal wave does NOT contain multiple frequency components, and is NOT easily created by a saxophone. It is simply a pure tone with a bandwidth of 440 Hz.

True/False: every audio waveform-- whether speech, music, or any other sound -- can be built out of sinusoids at certain frequencies? (5 points)
True – All sound can be made up as the sum of pure tones.

What are the five major components of a telephone system: (15 points)

1. The microphone
2. The transmission system
3. The receiver
4. The switching system
5. The signaling system

The standard sampling rate on a CD for digital audio is 44.1 kHz, which represents a rate about ?% higher than the Nyquist rate.
(How much does the ?% represent?)(5 points)

(44.1-40) / 40 = 10.25%

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Describe at least 3 advantages in using digitized audio over analog audio in communications systems. (15 points)

Digitized audio can be compressed, thereby making more efficient use of system bandwidth,
Digitized audio can be used in a packet switched environment, thereby making further reductions in system bandwidth,
Digitized audio is much more amenable to encryption and encoding.
Digitized audio can be transmitted over fiber optic cables. (analog audio cannot).

The distance between Jupiter and Earth is on average 390,692,622 miles. How long (in seconds) would it take for a command given on Earth to reach the Galileo satellite orbiting Jupiter? (10 points)

390,692,622 miles/186,282 miles/sec = 2097 seconds = 35 minutes

What is the primary physical origin of the limit that prevents zero latency, infinite bandwidth, and infinite information rates? (10 points)

The speed of light

True/False: In a fiber optic cable, the index of refraction of the center conductor is lower than that of the cladding surrounding it. (5 points)
False - the index of refraction of the center conductor is higher than that of the cladding surrounding it.

True/False: A world wide cellular telephone system would not be possible without current computer technology, (5 points)
True – Today's cellular telephone systems use highly sophisticated computer systems.

The Receiver sensitivity of a cellular phone requires about: (10 points)

- [ ] one microwatt
- [ ] one kilowatt
- [ ] one nanowatt
- [x] one picowatt
- [ ] none of the above

of power in its received signal to work effectively.

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COEN 001 Midterm Exam #2 Solution Fall 2002

Why do most telephone systems choose to use fiber optic cable as opposed to geosynchronous satellites for communication? (10 points)

Fiber optic systems have a **significantly** greater bandwidth, AND most importantly, because a geosynchronous satellite is at a distance of 23,500 miles from earth, the transmission delay would be (23,500*2)/186000 = .25269 seconds in each direction for about a ½second delay experienced by each person. VERY ANNOYING!

The overall GPS system contains only three elements. What are they? (15 points)

1. the satellites
2. the receivers
3. the system control center, which monitors the health and accuracy of the.satellites.

A DVD offers increased data capacity over conventional CD technology by utilizing what two techniques? (10 points)

1. decreasing the pit size
2. decreasing the track spacing

A telephone network T1 transmission line is capable of which of the following maximum communication speeds? (10 points)

- [ ] 16 kbps
- [ ] 192 kbps
- [ ] 64 kbps
- [x] 1.544 Mbps
- [ ] none of the above

True/False: In an Ethernet LAN, each connected device waits to transmit its messages in a round robin sequence. (5 points)
False – Any devices wishing to transmit a message will attempt to do so as soon as it detects that no other device is currently transmitting.