

Q1)

a)

To digitize this sound, the analogue waveform is sampled – that is, it is measured at successive instants in time, then quantization it, finally coding.

We use 64 kbit/s since digital telephone system the sampling rate is 8000 times a second and 8-bit words are used, so $8000 \times 8 = 64\,000$ bit/s

Word size effects on bit-rate.

16-bit word size $\Rightarrow 8000 \times 16 = 128\,000$ bit/s = 128 Kbit/s.

To prevent such intrusions, in practical recording equipment sounds above 20 kHz (the notional upper limit of human hearing) are filtered off prior to sampling. The impossibility of achieving a sharp cut-off frequency on a filter is one of the reasons for sampling at around 44 kHz rather than 40 kHz.

b) i)

Twisted pair: the signals on two wires are equal in size but opposite in their effect, so any interference caused by one of the pair is cancelled out by other wire in the pair, also the attenuation depended on the dimensions of the cable on the material used and on the frequency of operation.

Coaxial cable: the signal being protected from interference by the outer conducting sheath, the attenuation depended on the dimensions of the cable, the spacer material and the frequency.

The attenuation is measured in dB on both coaxial-cable and twisted-pair.

In an optical fiber, crosstalk is avoided by preventing the radiation escaping, the loss of light represents a loss of the signal and contributes to the attenuation of the signal, and other losses take place when the light interacts with impurities in the glass, there isn't any interference occurred in this media of light.

ii)

The loss in twisted pair is 6 dB/km, a 3dB loss will occur over
 $3 \text{ dB} \div 6 \text{ dB/km} = 500 \text{ m.}$

The loss in coaxial cable is 1.5 dB/km, a 3dB loss will occur over
 $3 \text{ dB} \div 1.5 \text{ dB/km} = 2 \text{ Km.}$

The loss in Fiber optical is 0.3 dB/km, a 3dB loss will occur over
 $3 \text{ dB} \div 0.3 \text{ dB/km} = 10 \text{ Km.}$

iii)

We should use repeater hub to amplify the signal.

Q2)

Overview about LAN

LAN refer to Local Area Network, a data communication network used to connect or link computers, printers etc. within a limited geographical area. It uses repeater hub to regenerate the signal to prevent it from destroy and reduce the attenuation also each personal computer has specific IP address to distinguish each PC from other.

Principle of operation of repeaters: a device used to detect, amplify, reshape and re-transmit a digital bit-stream; also each packet received and sends it out on all other ports.

Bridges a device that connects together two parts (collision domain) of LAN and forwards data packets between them, also it has forward table use to reduce the collision and it can know where port it should send the packets.

Switch a device that transfer data from an input interface to a selected output interface in a communication system. Typically a switch connects networks of the same type.

Router is a device that is most often used to connect from one network (LAN or WAN) to another.

In figure the “a” indicate to Fast Ethernet refers to 100 Mbit/s and limits the distance that a frame can be sent within a collision domain. But “f” indicate to Gigabit Ethernet refers to 1000 Mbit/s and requires a frame extension for half-duplex (CSMA/CD) operation.

Carrier sense multiple access with collision detection (CSMA/CD) this protocol protocols limits on the distance between nodes, and the number of computers that share a collision domain; also Transmission Control Protocol / Internet Protocol (TCP/IP) allow many users to use the Internet.

Picture size (176× 144)

$176 * 144 = 25,344$ pixels (High × Width)

$25,344 * 8 = 202,752$ bits; (8 bit)

$202,752 * 15 = 3,041,280$ bit/second (15 Frame / Sec – bit-rate) ≈ 3 Mbit/s

By Compress process with ratio 10:1

$3,041,280 / 10 = 304,128$ bit

Audio + Video = 64Kbit + 3,041,280 ≈ 3 Mbit/s (Without Compress)

Audio + Video = 64Kbit + 304,128 < 0.5Mbit/s (With Compress)

In both cases less than 10 Mbit/s, i.e. we can use 10 Mbit/s bandwidth without any difficult.

Q3)

a)

b)

c)

The maximum propagation delay is:

Time for the reception of the data:

$$v=d/t \Rightarrow t=d/v = 20000/3.06108 = 6533 \text{ s.}$$

Time for the retransmission of the received data, taking into account the circumference of the circle to be covered by the signal: $t = (d+2 \pi r)/v = (20000 + 2 \pi * 30000)/3.06108 = 68.08*10^3 \text{ s}$

So the propagation delay is: $(6.533*10^3 + 68.08*10^3) = 74.613*10^3 \text{ s} = 149.226 \text{ ms.}$

For a geostationary system, $d = 36 \text{ Mm}$ the propagation delay is 23582.102 ms