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Final Assignment

[1] Define analog transmission:

An analog signal is characterised by being continuously variable along both amplitude and frequency. It is a method of conveying information using a continuous signal which varies a amplitude, phase, other property in proportion to that information. To transmit an analog signal effectively, we need to define the frequency in which is operates.

According to my ID,

Here, $B = 7$ Kbps = bit rate = N;

& baud rate, $H = 2$ Kbaud = S;

data elements, $r = ?$

signal elements, $L = ?$

We know,

$$S = N \times \frac{1}{r}$$

$$\Rightarrow r = \frac{N}{S} = \frac{7 \text{ Kbps}}{2 \text{ kbaud}} = \frac{7000 \text{ bits}}{2000 \text{ baud}} = 3.5 \text{ bits/baud}$$

$$r = \log_2 L \Rightarrow L = 2^r = 2^{3.5} = 11.31$$

$\therefore$ data element = 3.5 bits/baud

& signal element = 11.31

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$\boxed{\text{Ans. to the ques. no-2}}$

Carrier signal and it's role in analog transmission:

A carrier is a single-frequency signal that has one of it's characteristics (amplitude, frequency, phase) changed to represent the baseband signal.

ⓐ B kbps, FSK $(B=7)$

Here,

B kbps $= 7000$ bps $= N$ ∴ $S = \frac{1}{r} \times N$

FSK $= L = 2$ $= \frac{1}{1} \times 7000$

$r = \log_2 L = \log_2 2 = 1$ $= 7000$ baud

ⓑ C kbps, ASK $(c=3)$

Here,

C kbps $= 3000$ bps $= N$ ∴ $S = \frac{1}{r} \times N$

ASK $= L = 2$ $= \frac{1}{1} \times 3000$

$r = \log_2 L = \log_2 2 = 1$ $= 3000$ baud

ⓒ D kbps, QPSK $(D=4)$

Here,

D kbps $= 4000$ bps $= N$ ∴ $S = \frac{1}{r} \times N$

QPSK $= L = 4$ $= \frac{1}{2} \times 4000$

$r = \log_2 L = \log_2 4 = 2$ $= 2000$ baud

ⓓ E kbps, 64-QAM $(E=4)$

Here,

E kbps $= 4000$ bps $= N$ ∴ $S = \frac{1}{r} \times N$

64-QAM $= L = 64$ $= \frac{1}{6} \times 4000$

$r = \log_2 L = \log_2 64 = 6$ $= 666.67$ baud.

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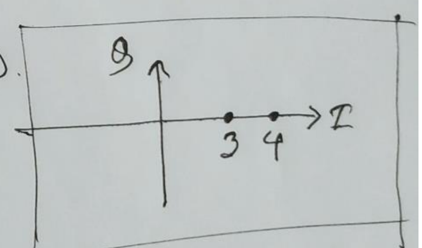
Ans. to the ques. no-03

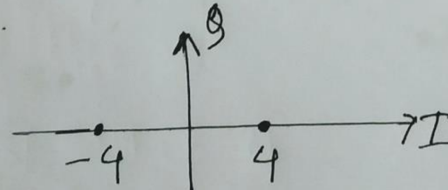
Constellation diagram and it's role in analog transmission:

A constellation diagram can help to define the amplitude and phase of a signal element, particularly when we are using two carries. The diagram is useful when we are dealing with multilevel ASK, PSK or QAM. In a constellation diagram, a signal element type is represented as a dot. The bit or combination of bit's it can carry is often written next to it. The diagram has two axes. The horizontal X-axis is related to the in-phase carrier. The vertical Y-axis is related to the quadrature carrier.

ⓐ ASK, with peak amplitudes of C and D.
Here, C = 3, D = 4 ⟶



ⓑ BPSK, with a peak amplitudes of E.
We have two signal elements with the same peak amplitude of E = 4.



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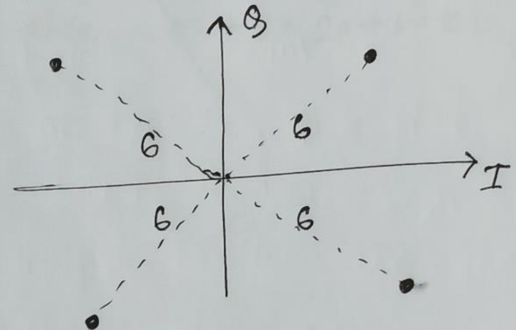
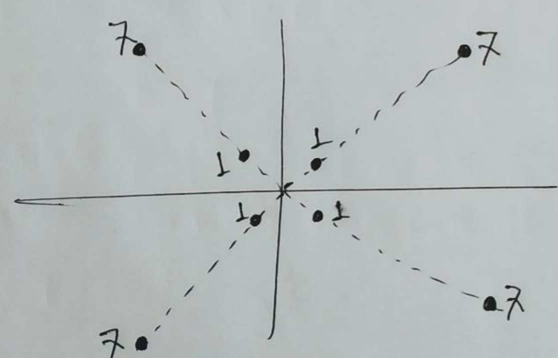
(c) QPSK, with a peak value of F = 6.
Here, for QPSK we have four signal elements with same peak amplitude. There must be 90 degrees difference between each phase. Assuming first phase to be at 45°, then other's will be at 135°, 225°, 315°.



(d) 16 QAM, with different peak amplitude, A and B. and four different phases. A = 1, B = 7



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Ans. to the ques. no- 4

Here, $B=7, C=3, D=4, E=4$;

$CD = 34$,

1 Mbps = 1000 kbps. 4 Mbps = 4000 kbps = 4000,000 bps.

ⓐ frame size $= CD+1 = 34+1 = 35$ bit

~~ⓑ frame rate~~ $= \frac{1}{\text{frame duration}} = \frac{1}{\text{input slot duration}}$

ⓑ frame rate $= \frac{4000{,}000}{1}$ =

$= 4000{,}000$ frame/s.

ⓒ frame duration $= \frac{1}{\text{frame rate}} = \frac{1}{4000{,}000} = 2.5 \times 10^{-7}$ µs.

ⓓ Data rate = frame rate × frame size

$= 4000{,}000 \times 35 = 140 \times 10^{6}$

ⓔ efficiency $= \frac{\text{useful bit}}{\text{total sent bit}} = \frac{34}{35} = 0.9714 = 97.14\%$.

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Ans. to the ques. no - 5

Here,
$C = 3$ channels, 4 Mbps = 4000 kbps
$D = 4$ channels, 2 Mbps = 2000 kbps
We combine three 4000 kbps sources into four 2000 kbps.
Now, we have five 4000 kbps channel.

(a) Each output frame carries 1 bit from each of the ~~seven~~ ~~4~~ five 4000 kbps.
frame size $= 5 \times 1 = 5$ bits.

(b) Frame ~~rate~~ duration $= 1/4000,000 = 2.5 \times 10^{-7}$ s

(c) Frame ~~duration~~ rate $= 4000,000$

(d) output data rate = (4000,000 frame/s) $\times 5 = 2$ Mbps.
We can also calculate the output data rate as the sum of input data rate because there is no synchronizing bits. output data rate
$= 3 \times 4000 + 4 \times 2000$
$= 2$ Mbps.

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Ans. to the ques. no-06

ABC = 173 kbps
ABD = 174 kbps

We need to add extra bits to the second source to make both rates = 173 kbps. Now we have two sources, each of 173 kbps.

The frame carries 1 bit from each source.

(a) frame size = 1 + 1 = 2 bits.

(b) Each frame carries 1 bit from each 173,000 bps source.

$\therefore$ frame rate $= \frac{173,000}{1} = 173,000$ frame/s

(c) frame duration $= \frac{1}{\text{frame rate}} = \frac{1}{173,000} = 5.78 \times 10^{-6}$

(d) data rate = 173,000 × 2 bits = 346 kbps.

Here, output bit rate is ~~[illegible]~~ smaller than the sum of the input rate.

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Ans. to the ques. no-07

Describe the goal of Multiplexing:

Multiplexing is the ~~goal o~~ set of techniques that allows the simultaneous transmission of multiple signals across a signal data link. The goal is to share an expensive resource. Multiplexing is provided by the physical layer of the OSI Model.

Here, EFG = 465 kbps
AB = 17 KHz

The bandwidth allocated to each voice channel is ~~17000/365~~ = 17000/465 = 36.55 Hz. Each voicemail has data rate of 64 kbps. This means that modulation technique users 64000/36.55 = 1751.03 bit/Hz.

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Ans. to the ques. no - 08

Here,
$AC = 13$ voice channels.
$B = 7Hz$

Assume that a voice channel occupies a bandwidth of 4KHz. To multiplex 13 voice channels, we need 12 guard bands. The required bandwidth is then ~~$B = (4KHz) \times 13 + (7Hz)$~~

$$B = (4000Hz) \times 13 + (7Hz) \times 12$$
$$= 52084 Hz = 52.084 KHz.$$