

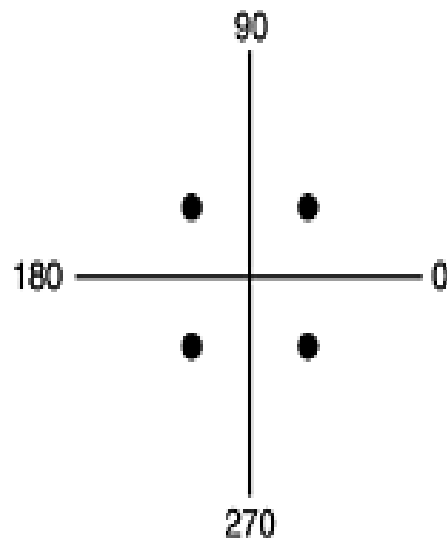
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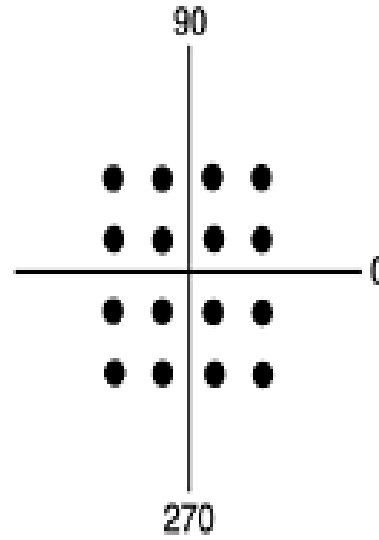
Answer:

- Like a single railroad track, it is half duplex. Oil can flow in either direction, but not both ways at once.

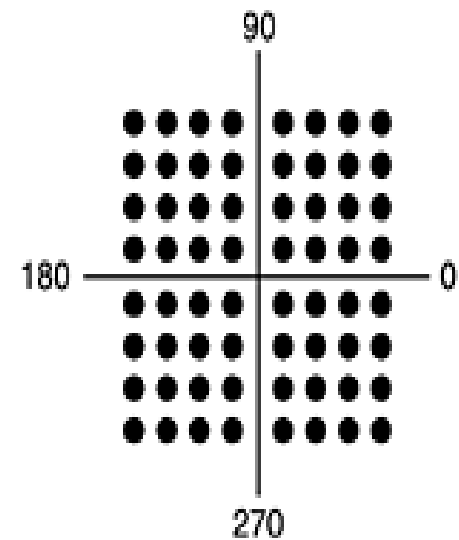
- Q 22. A modem constellation diagram similar to Fig. 2-25 has data points at the following coordinates: $(1, 1)$, $(1, -1)$, $(-1, 1)$, and $(-1, -1)$. How many bps can a modem with these parameters achieve at 1200 baud?



(a)



(b)



(c)

Answer:

- There are four legal values per baud, so the bit rate is twice the baud rate. At 1200 baud, the data rate is 2400 bps.

- Q. 23 A modem constellation diagram similar to Fig. 2-25 has data points at $(0, 1)$ and $(0, 2)$. Does the modem use phase modulation or amplitude modulation?

- Answer:

The phase shift is always 0, but two amplitudes are used, so this is straight amplitude modulation.

- Q 24:

In a constellation diagram, all the points lie on a circle centered on the origin. What kind of modulation is being used?

- Answer:
- If all the points are equidistant from the origin, they all have the same amplitude, so amplitude modulation is not being used. Frequency modulation is never used in constellation diagrams, so the encoding is pure phase shift keying.

- How many frequencies does a full-duplex QAM-64 modem use?

Answer:

- Two, one for upstream and one for downstream. The modulation scheme itself just uses amplitude and phase. The frequency is not modulated.

- Q 26. An ADSL system using DMT allocates $\frac{3}{4}$ of the available data channels to the downstream link. It uses QAM-64 modulation on each channel. What is the capacity of the downstream link?

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Answer:

In Discrete multitone (**DMT**) there are 256 channels in all, minus 6 for POTS (Plain old telephone service) and 2 for control, leaving 248 for data.

If $\frac{3}{4}$ of these are for downstream, that gives 186 channels for downstream. ADSL modulation is at 4000 baud, so with QAM-64 (6 bits/ baud) we have 24,000 bps in each of the 186 channels.

The total bandwidth is then 4.464 Mbps downstream.

- Q 28. Ten signals, each requiring 4000 Hz, are multiplexed on to a single channel using FDM. How much minimum bandwidth is required for the multiplexed channel? Assume that the guard bands are 400 Hz wide.

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Answer:

There are ten 4000 Hz signals.

We need nine guard bands to avoid any interference.

The minimum bandwidth required is $4000 \times 10 + 400 \times 9 = 43,600$ Hz.

Q 29 Why has the PCM sampling time been set at 125 μ sec?

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Answer:

A sampling time of 125 μsec corresponds to 8000 samples per second. According to the Nyquist theorem, this is the sampling frequency needed to capture all the information in a 4 kHz channel, such as a telephone channel. (Actually the nominal bandwidth is somewhat less, but the cutoff is not sharp.)

- Q 30 What is the percent overhead on a T1 carrier; that is, what percent of the 1.544 Mbps are not delivered to the end user?

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Answer:

The end users get $7 \times 24 = 168$ of the 193 bits in a frame.

The overhead is therefore $25/193 = 13\%$.