4.

For a Bandlimit & Time limit waveform channel.

$$C = W \log_2 \left(1 + \frac{P}{WN_0}\right) \text{ bits/sec}$$

1. $C \to \infty$ as $P \to \infty$ if W, N_0 remains constant

2. Suppose P is fixed, N_0 is fixed.

W is increasing

$$\lim_{W \to \infty} W \log_2 \left(1 + \frac{P}{WN_0}\right)$$

$$C = \lim_{\frac{P}{WN_0} \to 0} \log_2 e \cdot \frac{\ln\left(1 + \frac{P}{WN_0}\right)}{P/WN_0} \cdot \frac{P}{N_0}$$

$$= (\log_2 e) \frac{P}{N_0} \lim_{\frac{P}{WN_0} \to 0} \frac{\ln\left(1 + \frac{P}{WN_0}\right)}{\left(\frac{P}{WN_0}\right)}$$

$$= (\log_2 e) \frac{P}{N_0}$$

$$C \approx 1.44 \frac{P}{N_0}$$

as $W \to \infty$ the channel capacity attains a constant value.

We know from channel coding theorem.

$R \to$ bitrate

$R < C$

then as $\omega \uparrow \Rightarrow C \to$ constant

Hence,
$\Rightarrow$ we cannot increase arbitrarily Bitrate

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