

First Name :..... **Last Name:** **G:**.....

An FDM system uses a total bandwidth of **10 MHz** to transmit multiple channels.

- Each channel requires **250 kHz** , A guard band of **25 kHz** is placed between adjacent channels .
- The system must reserve **10% of the total bandwidth** to avoid overall interference

Questions:

- What is the **effective usable bandwidth**?

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- How many channels can be multiplexed?

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- What is the **total wasted bandwidth** (guard bands + reserved portion)?

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- Propose a method to **improve spectral efficiency**

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Correction

Total bandwidth: 10 MHz
Channel bandwidth: 250 kHz
Guard band: 25 kHz
Reserved bandwidth: 10%

1. What is the effective usable bandwidth? [1.5 pts]

Reserved bandwidth = $10\% \times 10 \text{ MHz} = 1 \text{ MHz}$
Usable bandwidth = $10 - 1 = 9 \text{ MHz}$

Answer: 9 MHz

2. How many channels can be multiplexed? [1.5 pts]

Bandwidth per channel = $250 + 25 = 275 \text{ kHz}$
Number of channels = $9000 / 275 \approx 32.72$

Answer: 32 channels

3. What is the total wasted bandwidth? [2 pts]

Reserved = 1 MHz
Guard bands = $(32 - 1) \times 25 = 775 \text{ kHz} = 0.775 \text{ MHz}$

Total wasted = $1 + 0.775 = 1.775 \text{ MHz}$

Answer: 1.775 MHz

4. Propose a method to improve spectral efficiency. [1 pt]

Possible solutions:

- Reduce guard bands using better filters
- Use more efficient modulation techniques
- Apply data compression

Answer: Reduce guard bands or use efficient modulation