



SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution

Coimbatore-35



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade(III Cycle)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB301-ANALOG AND DIGITAL COMMUNICATION

III YEAR/ V SEMESTER

UNIT 4 – DIGITAL MODULATION TECHNIQUES

TOPIC – BANDWIDTH EFFICIENCY



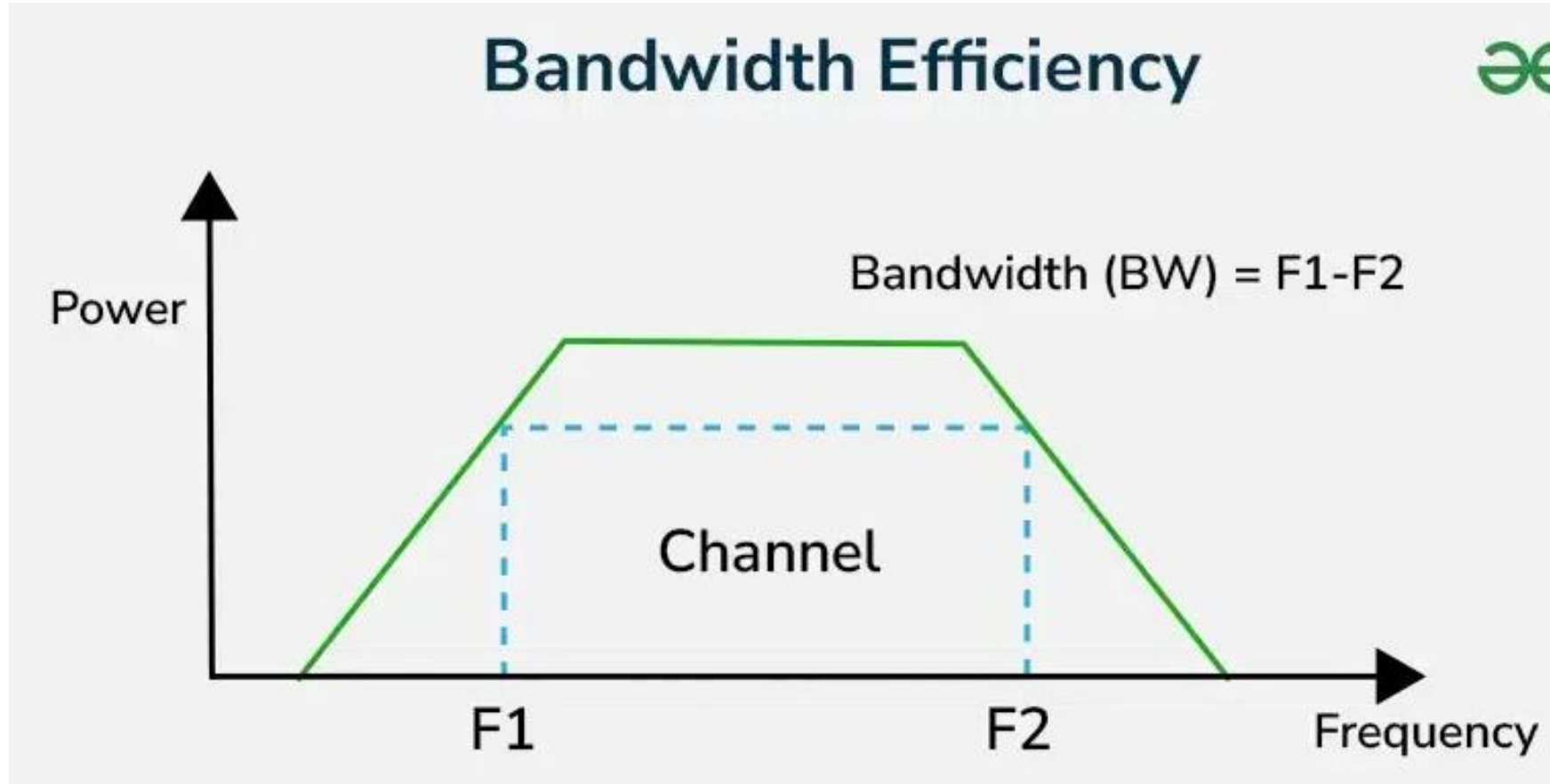
DEFINITION



- Bandwidth efficiency, also known as spectral efficiency, is a measure of how well a digital modulation technique can accommodate data within a limited bandwidth.
- It's calculated by dividing the bit rate by the bandwidth of the modulated signal. Bandwidth efficiency is typically calculated as the ratio of the data rate to the bandwidth used.

$$\text{Bandwidth Efficiency} = \text{Data Rate} / \text{Bandwidth}$$

Bandwidth is measured in Hertz (Hz) The result is expressed in bits per second per Hertz (bps/Hz).





- It is a measure of how well a small network is used by a physical protocol and is sometimes used as a simple method of control (network connectivity).
- Connectivity indicates the performance of a digital communications system measured in bits/s/Hz or more rarely but obviously at (bit/s)/Hz.
- Alternatively, speed performance can be measured in bits/symbol, equivalent to bits per channel (bpcu);
- This means the net signal divided by the signal rate (modulation rate) or pulse rate. It is sometimes used to analyze the performance of digital models or linear models in combination with error correction (FEC) and other advanced features.



- In the second case, "bit" refers to the user's small data.

$$\text{Spectral Efficiency}_{5G} = \frac{\text{5G NR Throughput, bps/Channel (Band)}}{\text{Bandwidth, Hz}}$$

- This metric helps evaluate how effectively a communication system uses its allocated frequency spectrum.
- A higher value indicates more efficient use of the available bandwidth. Bandwidth efficiency: Spectral efficiency usually is expressed as “bits per second per Hertz,” or "bits/s/Hz". In other words, it can be defined as the net data rate in bits per second (bps) divided by the bandwidth in hertz.



Factors that Affects Bandwidth Efficiency



1. Compression
2. Protocol Overhead
3. Transmission Method
4. Data Redundancy
5. Network Setup



Advantages of Bandwidth Efficiency



1. Enhanced E-Commerce Performance
2. Soft Communication
3. Reduced Downtime
4. Support for high bandwidth applications



Disadvantages of Bandwidth Efficiency



1. Another problem with speed is the high cost.
2. Broadband can be expensive and can limit internet usage and data access for organizations on a budget that cannot afford broadband.
3. The more networks you need, the higher the costs.
4. Noise issue.
5. Large check marks.



Applications of Bandwidth Efficiency



- These are the most important metrics to get an idea about the speed and quality of the network.
- Broadband is usually measured in bits per second (bps).
- Typically, organizations and internet service providers (ISPs) measure bandwidth in megabits per second (Mbps) or gigabits per second (Gbps).
- Some apps that require bandwidth are music streaming apps like Pandora and iTunes. Video applications such as Skype and VoIP.



- Social media users can also benefit from broadband with Facebook Youtube and Dropbox are also broadband applications.
- Likewise, broadband devices and applications require a high-speed Internet connection.
- Network management tools are necessary to manage network traffic and prioritize data transfer.
- Having higher bandwidth allows you to achieve higher data transfer speeds, resulting in shorter download times.
- This is especially important when downloading large files.



ASSESSMENT



1. Define Bandwidth Efficiency
2. What is meant by spectrum Efficiency
3. Mention the advantages of Bandwidth efficiency



THANK YOU