

A
PROJECTREPORT
ON
MICROPROJECTON
<<“bandwidth”>>

(COMPUTERNETWORKING(4340703))

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Introduction to bandwidth

Bandwidth refers to the maximum amount of data that can be transmitted over a network connection in a given period, typically measured in bits per second (bps). It determines the speed and capacity of a communication channel, such as an internet connection, fiber-optic cable, or wireless network.

Higher bandwidth allows for faster data transfer and smoother online experiences, such as streaming, gaming, or video conferencing. It is an essential factor in networking, telecommunications, and computing, influencing performance and efficiency in digital communication.

Requirements of bandwidth

Bandwidth Hardware and Software Equipment

Bandwidth performance depends on both hardware and software components that facilitate data transmission, network management, and optimization.

1. Hardware Equipment for Bandwidth

A. Network Infrastructure Devices

1. Routers

Directs internet traffic between devices and networks.

Modern routers support Wi-Fi 6, 5G, and Gigabit Ethernet for higher bandwidth.

Example: TP-Link AX11000, Netgear Nighthawk AX12.

2. Modems

Converts digital data into signals for transmission over ISP networks.

DSL, fiber-optic, and cable modems impact bandwidth capacity.

Example: ARRIS SURFboard SB8200 (supports up to 10 Gbps).

3. Switches

Manages data transfer within local networks (LAN).

Gigabit and 10G switches enhance bandwidth for enterprise setups.

Example: Cisco Catalyst 9300, Netgear GS108.

4. Hubs and Repeaters

Extend network reach by amplifying signals.

Useful in large network environments where data loss occurs due to distance.

B. Transmission Mediums

1. Ethernet Cables

Wired connections offer stable bandwidth.

Cat 5e, Cat 6, Cat 7, Cat 8 cables support speeds from 1 Gbps to 40 Gbps.

2. Fiber-Optic Cables

High-speed transmission (up to 1 Tbps) over long distances.

Used in ISPs, data centers, and large networks.

3. Wireless Access Points (WAPs)

Extends Wi-Fi coverage in large spaces.

Supports dual-band (2.4 GHz, 5 GHz) and tri-band Wi-Fi 6E for high bandwidth.

4. Network Interface Cards (NICs)

Installed in computers to enable high-speed wired and wireless connections.

10G NICs provide ultra-fast data transmission.

5. Load Balancers

Distribute network traffic to optimize bandwidth usage.

Used in data centers and enterprise networks.

Architecture/Code of Project (bandwidth)

```
import matplotlib.pyplot as plt

import random

# Simulate bandwidth usage over a period of time

def simulate_bandwidth_usage(num_days):

    bandwidth_usage = []

    for _ in range(num_days):

        usage = random.randint(0, 100) # Simulate random bandwidth usage

        bandwidth_usage.append(usage)

    return bandwidth_usage

# Plot bandwidth usage

def plot_bandwidth_usage(bandwidth_usage):

    days = list(range(1, len(bandwidth_usage) + 1))

    plt.plot(days, bandwidth_usage)

    plt.xlabel('Days')

    plt.ylabel('Bandwidth Usage (MB)')

    plt.title('Bandwidth Usage Over Time')

    plt.grid(True)

    plt.show()

# Main program

def main():

    num_days = 40 # Simulate bandwidth usage for 30 days

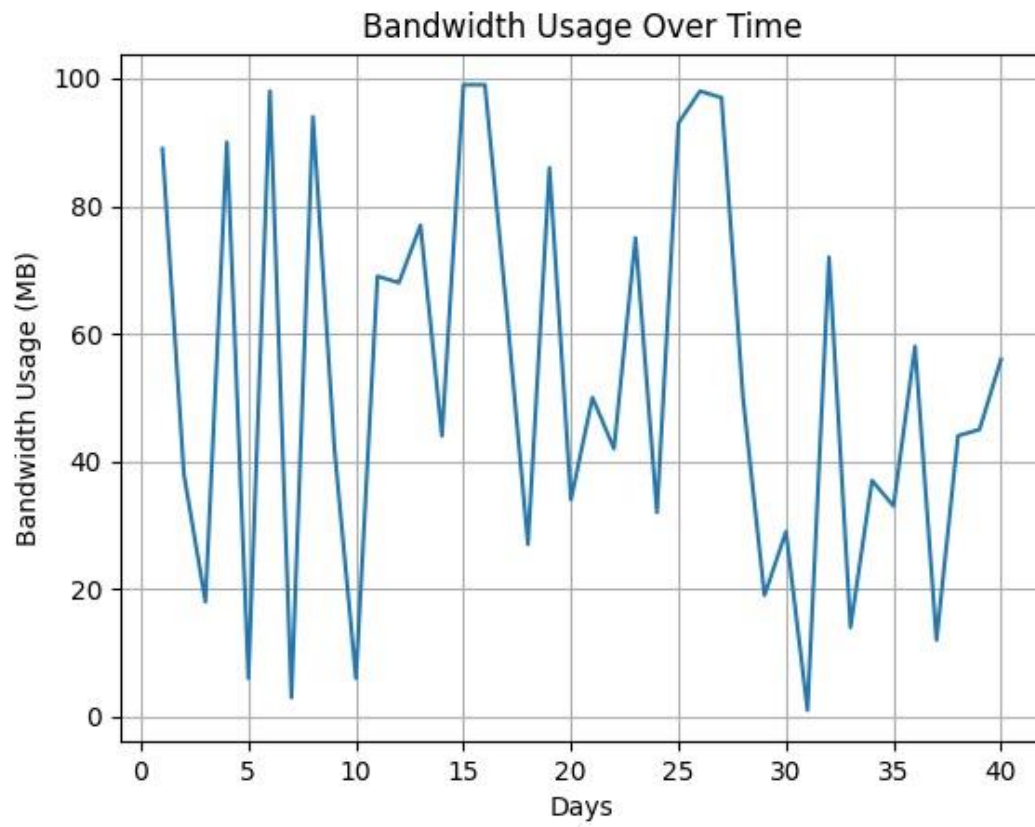
    bandwidth_usage = simulate_bandwidth_usage(num_days)

    plot_bandwidth_usage(bandwidth_usage)

if __name__ == '__main__':

    main()
```

Screenshotsofworkingproject/Output(wandwidth)



Application of bandwidth

The concept of bandwidth applies across various fields, primarily in networking, signal processing, and computing. Here are some key applications:

1. Networking & Communication

Internet Speed: Higher bandwidth allows faster data transmission, improving browsing, streaming, and downloads.

VoIP (Voice over IP): Ensures smooth voice calls without lag or distortion.

Video Streaming & Conferencing: Platforms like YouTube, Netflix, and Zoom require high bandwidth for HD video without buffering.

Cloud Computing: Efficient data transfer between cloud storage and local devices.

2. Signal Processing & Electronics

Radio & Television Broadcasting: Determines the quality of audio and video signals.

Radar Systems: High bandwidth enhances resolution and accuracy.

Medical Imaging (MRI, CT scans): Uses bandwidth to process and transmit high-quality images.

3. Computing & Data Transfer

Bus Systems in Computers: Data transfer speed in RAM, SSDs, and GPUs depends on bandwidth.

Peripheral Devices: USB, HDMI, and PCIe connections rely on bandwidth for performance.

4. Industrial & Scientific Applications

IoT (Internet of Things): Smart devices communicate efficiently using optimized bandwidth.

Big Data & AI Processing: High bandwidth is crucial for real-time analytics and machine learning models.

Advantages and Disadvantages of bandwidth

❖ Advantages of Bandwidth

1. **Faster Data Transmission** – Higher bandwidth allows for quicker downloads, streaming, and web browsing.
2. **Better Streaming Quality** – High bandwidth supports HD and 4K video streaming without buffering.
3. **Efficient Cloud Access** – Enables smooth access to cloud-based applications and storage.
4. **Multiple Device Support** – A high-bandwidth network can handle many devices simultaneously.
5. **Improved Online Gaming** – Reduces lag and latency, providing a smoother gaming experience.

❖ Disadvantages of Bandwidth

1. **Higher Costs** – More bandwidth often means higher internet service provider (ISP) costs.
2. **Network Congestion** – Limited bandwidth can cause slow speeds during peak usage times.
3. **Wasted Resources** – If not fully utilized, high bandwidth can be an unnecessary expense.
4. **Security Risks** – High bandwidth usage can attract cyber threats, like Distributed Denial of Service (DDoS) attacks.
5. **Infrastructure Limitations** – Some areas may not have access to high-bandwidth networks.

Summary of bandwidth

Bandwidth refers to the maximum rate at which data can be transmitted over a network or internet connection. It determines how fast information flows between devices.

Higher bandwidth means faster data transfer, better streaming, and smoother gaming.

Lower bandwidth can cause slow speeds, buffering, and network congestion.

Challenges include higher costs, security risks, and infrastructure limitations.

References

If you are looking for references on bandwidth, you can check the following sources:

Cisco: www.cisco.com (Networking concepts and bandwidth explanations)

IEEE Xplore: www.ieee.org (Research papers on bandwidth and network performance)

TechTarget: www.techtarget.com (IT and networking-related articles)

- Online Courses

Coursera: www.coursera.org (Networking courses from universities)

Udemy: www.udemy.com (Technical courses on bandwidth and networking)