Communications Technology

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طريقة الدخول للمقرر الدراسي عبر صفحة الانترنت

كليات الجامعة

- كلية التربية
- كلية العلوم
- كلية التجارة
- كلية الآداب
- كلية الزراعة
- كلية التربية النوعية
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- كلية الهندسة
- كلية الحقوق
- كلية الآثار
- كلية التمريض
- كلية الحاسبات والمعلومات

مدرس	تكنولوجيا المعلومات	د / أحمد محمد ربيع سيد		7

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البيانات الشخصية

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المقررات الدراسية

الأبحاث العلمية علي موقع الجامعه

There is no research

السيرة الذاتية

الموقع الشخصي


« تمهيدي ماجستير فنون تطبيق
« Wireless and Mobile Netwo
« Communication Terchnology
« Inbternet Applications
« Information Security


Course Description
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رابط الموقع الشخصي

http://staff.du.edu.eg/1058

Course Objectives

By the end of this course the student be able to:

1- Understand and apply the principles and practices of different communication technologies.
2- Identify the different types of multiplexing.
3- Understand Digitalization techniques.
4- Provide education and training of framing and formatting.
5- Understand Circuit-Switched Technology.
6- Demonstrate different transmission network media.
7- Explain SONET basics.
8- Understand Spread Spectrum.

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SONET Layers, SONET Frames.	5
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Course References

DATA COMMUNICATIONS AND NETWORKING, Behrouz A. Forouzan, McGraw-Hill Forouzan Networking Series, 2007.
Wireshark User' s Guide Version 3.7.0, Richard Sharpe, Ed Warnicke, Ulf Lamping, 2019.
Optical Networks, A Practical Perspective, Third Edition, Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki, AMSTERDAM, 2010.

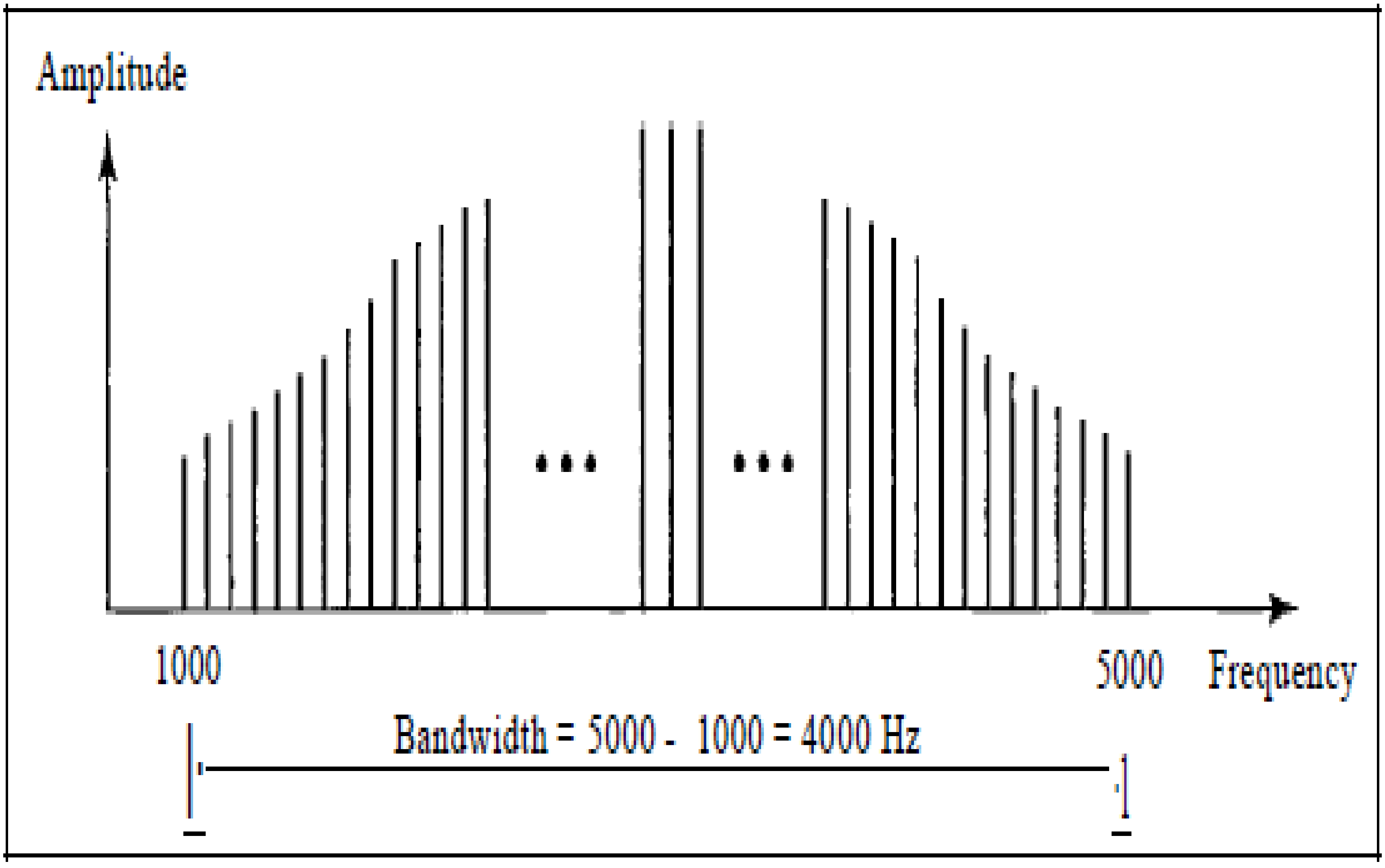
Chapter 1

Introduction

Communications technology, refers to all equipment and programs that are used to process and communicate information. Professionals in the communication technology field specialize in the development, installation, and service of these hardware and software systems. Individuals who enter this field develop an understanding in the conceptions, production, evaluation, and distribution of communication technology devices.

Communication technology refers to all the tools used to send, receive, and process information. In today's fast climate, efficiency and convenience are the keys to successful communication technology.

Bandwidth is the range of frequencies contained in a composite signal. The bandwidth of a composite signal is the difference between the highest and the lowest frequencies contained in that signal. For example, if a composite signal contains frequencies between 1000 and 5000, its bandwidth is 5000 - 1000, or 4000.


Amplitude
1000
5000
Frequency
Bandwidth = 5000 - 1000 = 4000 Hz

The term **bandwidth** can also refer to the number of bits per second that a channel, a link, or even a network can transmit. For example, one can say the bandwidth of a Fast Ethernet network (or the links in this network) is a maximum of 100 Mbps. This means that this network can send 100 Mbps.

There is an explicit relationship between the bandwidth in hertz and bandwidth in bits per seconds. Basically, an increase in bandwidth in hertz means an increase in bandwidth in bits per second. The relationship depends on whether we have baseband transmission or transmission with modulation.

In networking, we use the term bandwidth in two contexts.

- The first, bandwidth in hertz, refers to the range of frequencies in a composite signal or the range of frequencies that a channel can pass.
- The second, bandwidth in bits per second, refers to the speed of bit transmission in a channel or link.

The **throughput** is a measure of how fast we can actually send data through a network. Although, at first glance, bandwidth in bits per second and throughput seem the same, they are different. A link may have a bandwidth of B bps, but we can only send T bps through this link with T always less than B. In other words, the bandwidth is a potential measurement of a link; the throughput is an actual measurement of how fast we can send data.

Bandwidth utilization is the wise use of available bandwidth to achieve specific goals. Efficiency can be achieved by multiplexing; privacy and antijamming can be achieved by spreading.

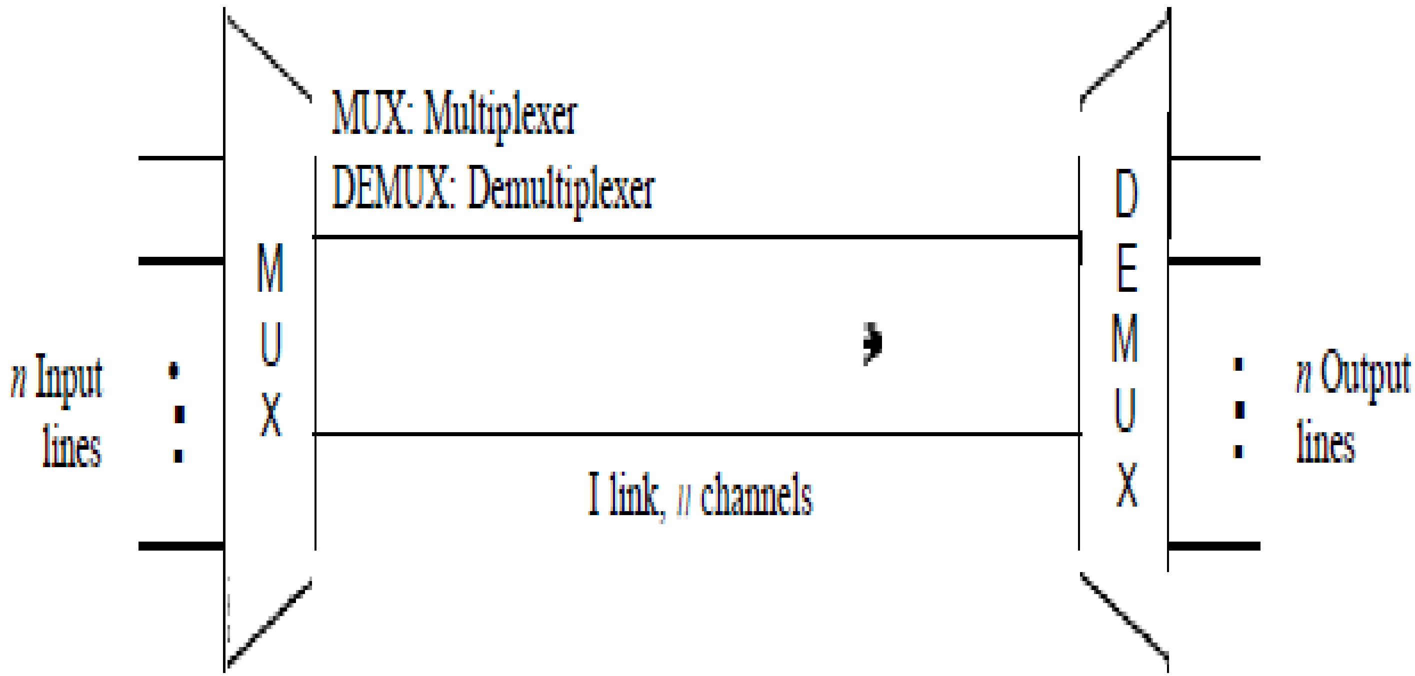
Two broad categories of **bandwidth utilization**: multiplexing and spreading. In multiplexing, our goal is efficiency; we combine several channels into one. In spreading, our goals are privacy and antijamming.

Multiplexing is the set of techniques that allows the simultaneous transmission of multiple signals across a single data link. As data and telecommunications use increases, so does traffic. Today's technology includes high-bandwidth media such as optical fiber and terrestrial and satellite microwaves.

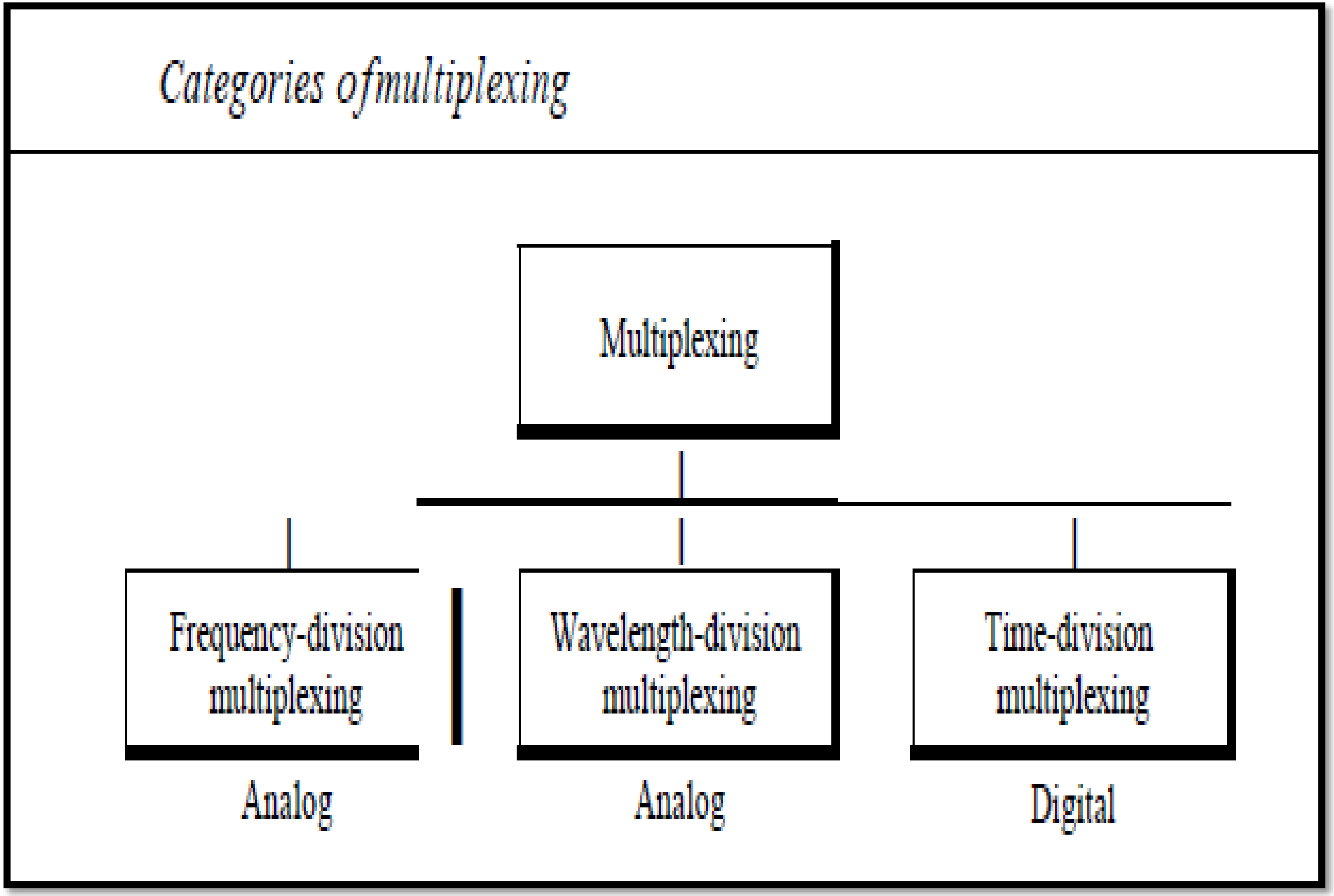
Each has a bandwidth far in excess of that needed for the average transmission signal. If the bandwidth of a link is greater than the bandwidth needs of the devices connected to it, the bandwidth is wasted. An efficient system maximizes the utilization of all resources; bandwidth is one of the most precious resources we have in data communications.

In a multiplexed system, n lines share the bandwidth of one link. In a multiplexed system, n lines share the bandwidth of one link. The basic format of a multiplexed system. The lines on the left direct their transmission streams to a multiplexer (**MUX**), which combines them into a single stream (many-to one). At the receiving end, that stream is fed into a demultiplexer (**DEMUX**), which separates the stream back into its component transmissions (one-to-many) and directs them to their corresponding lines.

Dividing a link into channels

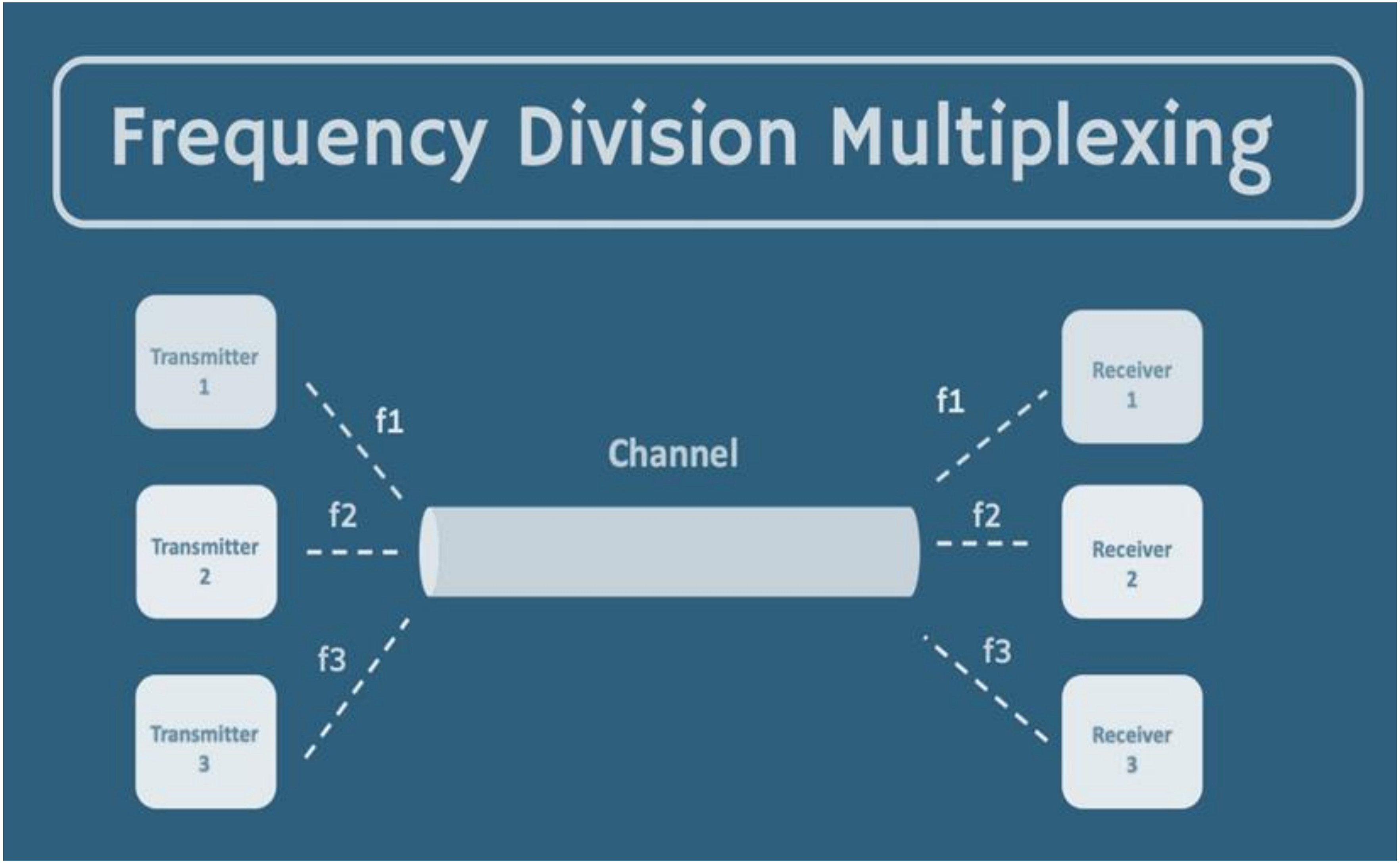


The word **link** refers to the physical path. The word **channel** refers to the portion of a link that carries a transmission between a given pair of lines. One link can have many (n) channels. There are three basic multiplexing techniques: frequency-division multiplexing, wavelength-division multiplexing, and time-division multiplexing. The first two are techniques designed for analog signals, the third, for digital signals.


Categories of multiplexing
Multiplexing
Frequency-division multiplexing
Wavelength-division multiplexing
Time-division multiplexing
Analog
Analog
Digital

1- Frequency-division multiplexing (FDM) is an analog technique that can be applied when the bandwidth of a link (in hertz) is greater than the combined bandwidths of the signals to be transmitted. In FDM, signals generated by each sending device modulate different carrier frequencies. These modulated signals are then combined into a single composite signal that can be transported by the link.

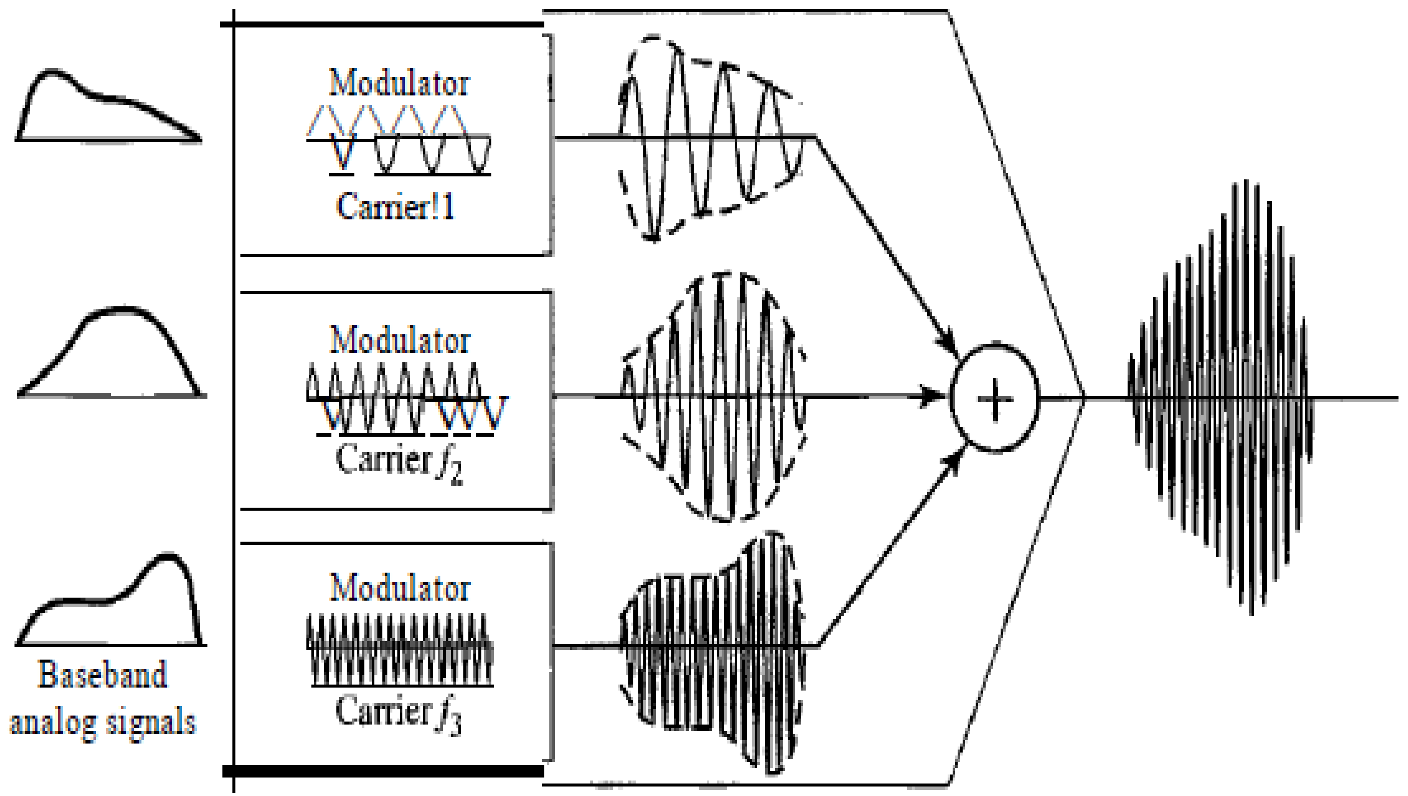
Carrier frequencies are separated by sufficient bandwidth to accommodate the modulated signal. These bandwidth ranges are the channels through which the various signals travel. Channels can be separated by strips of unused bandwidth-guard bands-to prevent signals from overlapping. In addition, carrier frequencies must not interfere with the original data frequencies.


Frequency Division Multiplexing
Transmitter 1
Transmitter 2
Transmitter 3
f1
f2
f3
Channel
f1
f2
f3
Receiver 1
Receiver 2
Receiver 3

FDM is an analog multiplexing technique that combines analog signals. We consider FDM to be an analog multiplexing technique; however, this does not mean that FDM cannot be used to combine sources sending digital signals. A digital signal can be converted to an analog signal.

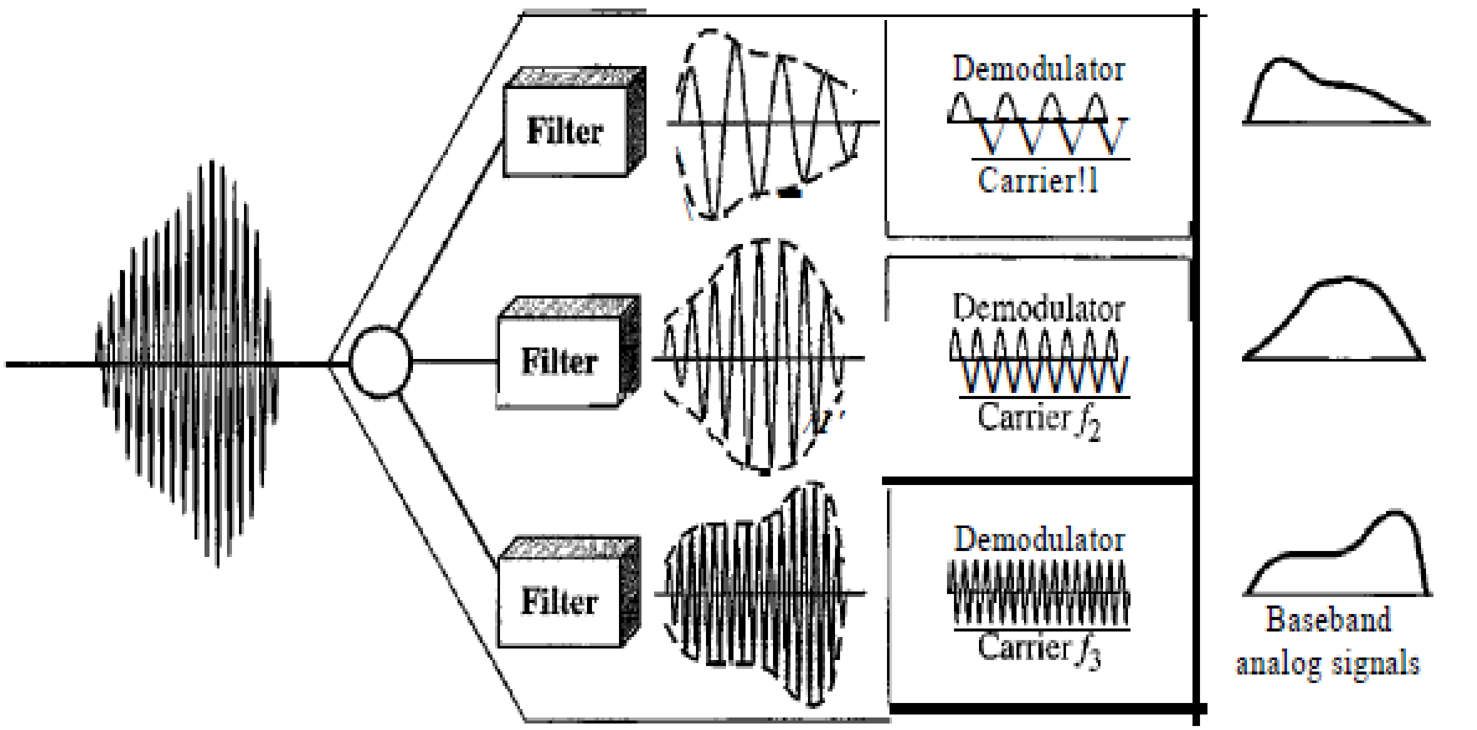
Multiplexing Process: Each source generates a signal of a similar frequency range. Inside the multiplexer, these similar signals modulates different carrier frequencies (f_1,f_2, and f_3). The resulting modulated signals are then combined into a single composite signal that is sent out over a media link that has enough bandwidth to accommodate it.

FDM process


Modulator
Carrier!1
Modulator
Carrier f_2
Modulator
Carrier f_3
Baseband
analog signals

Demultiplexing Process: The demultiplexer uses a series of filters to decompose the multiplexed signal into its constituent component signals. The individual signals are then passed to a demodulator that separates them from their carriers and passes them to the output lines. A conceptual illustration of demultiplexing process.

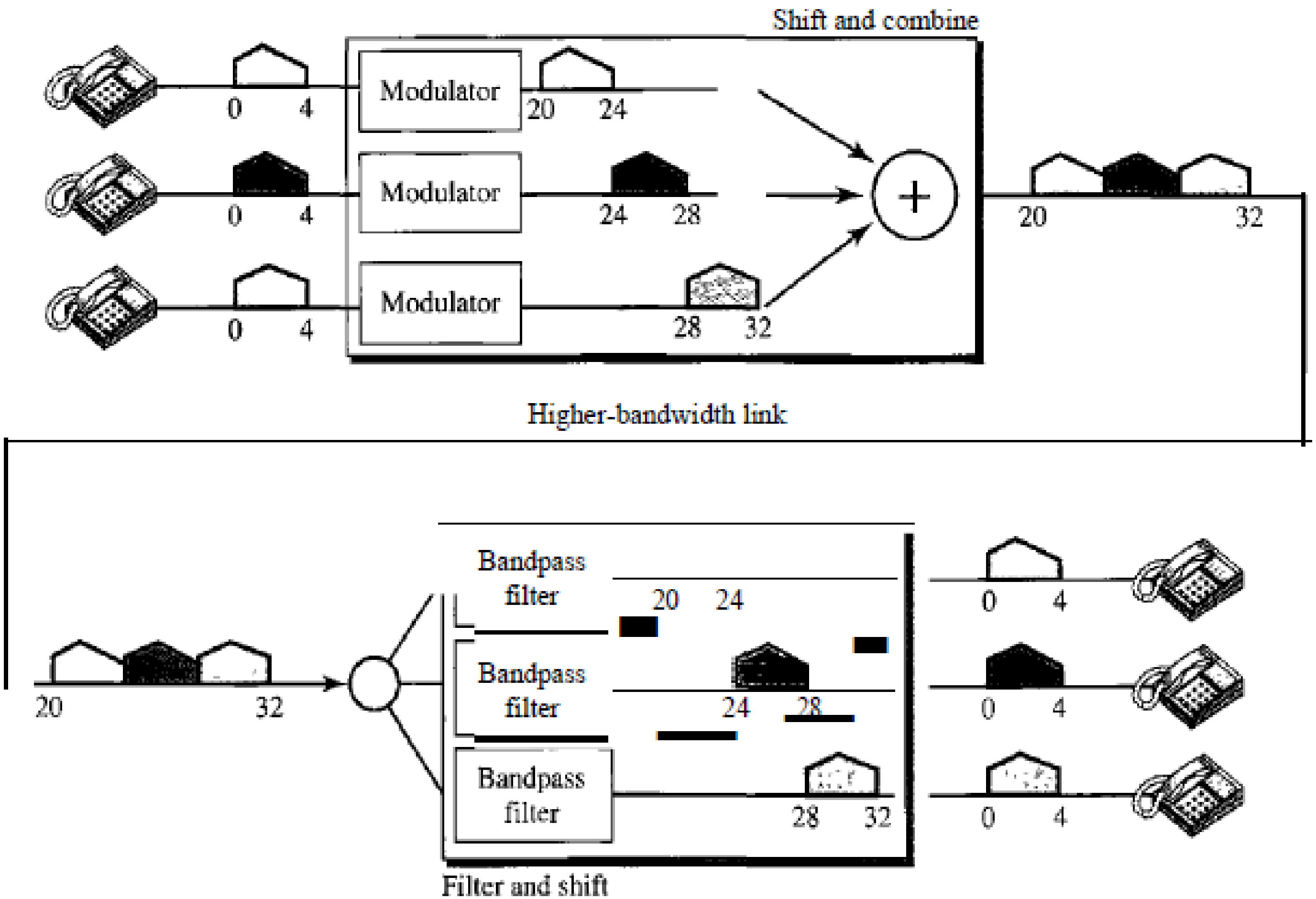
FDM demultiplexing example



Example 1:

Assume that a voice channel occupies a bandwidth of 4 kHz. We need to combine three voice channels into a link with a bandwidth of 12 kHz, from 20 to 32 kHz. Show the configuration, using the frequency domain. Assume there are no guard bands.

Example 1



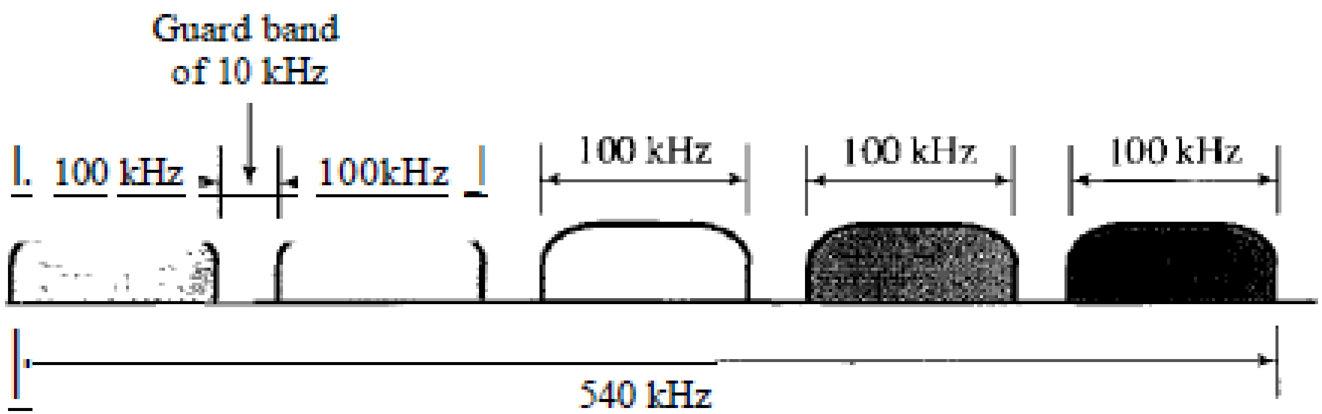
Shift and combine
Modulator
Modulator
Modulator
0
4
20
24
28
32
Higher-bandwidth link
Bandpass filter
Bandpass filter
Bandpass filter
Filter and shift

Example 2

Five channels, each with a l00-kHz bandwidth, are to be multiplexed together. What is the minimum bandwidth of the link if there is a need for a guard band of 10kHz between the channels to prevent interference?

For five channels, we need at least four guard bands. This means that the required bandwidth is at least 5 x 100 + 4 x 10 =540 kHz

Example 2

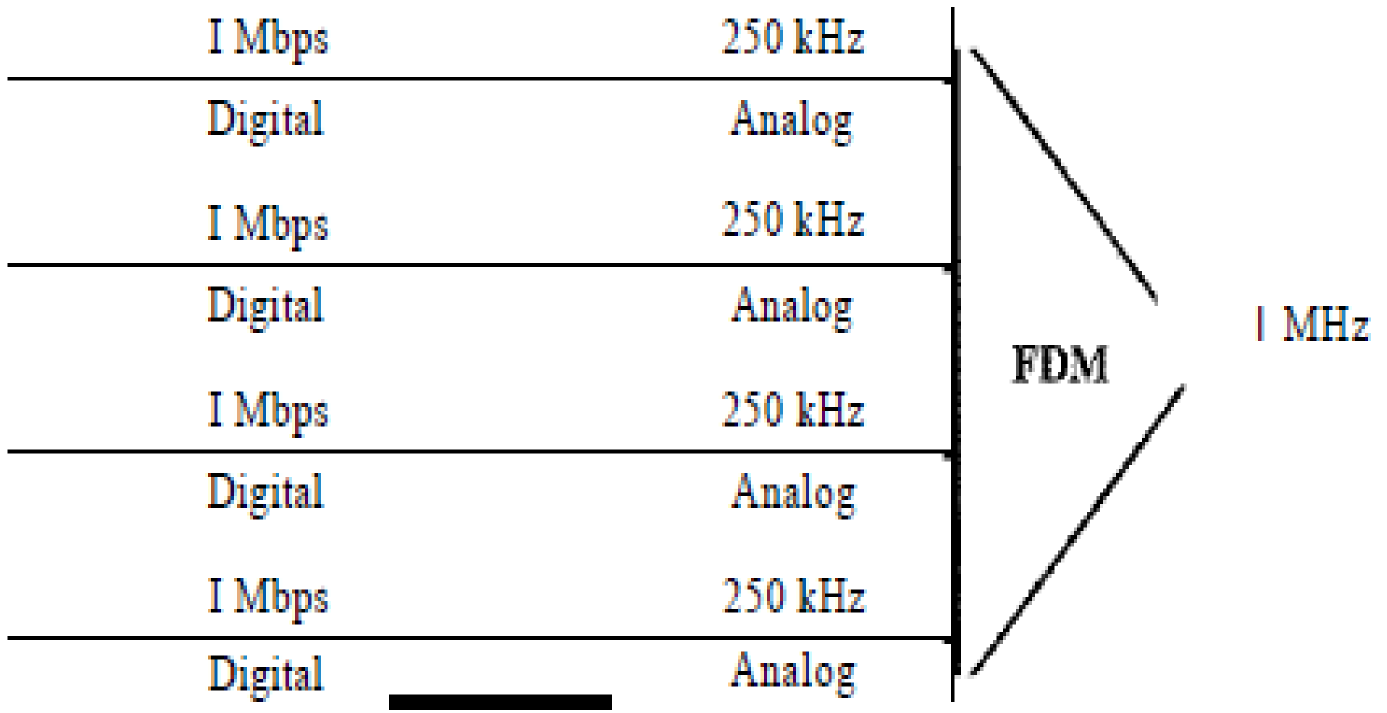


Example 3

Four data channels (digital), each transmitting at 1 Mbps, use a satellite channel of 1 MHz Design an appropriate configuration, using FDM.

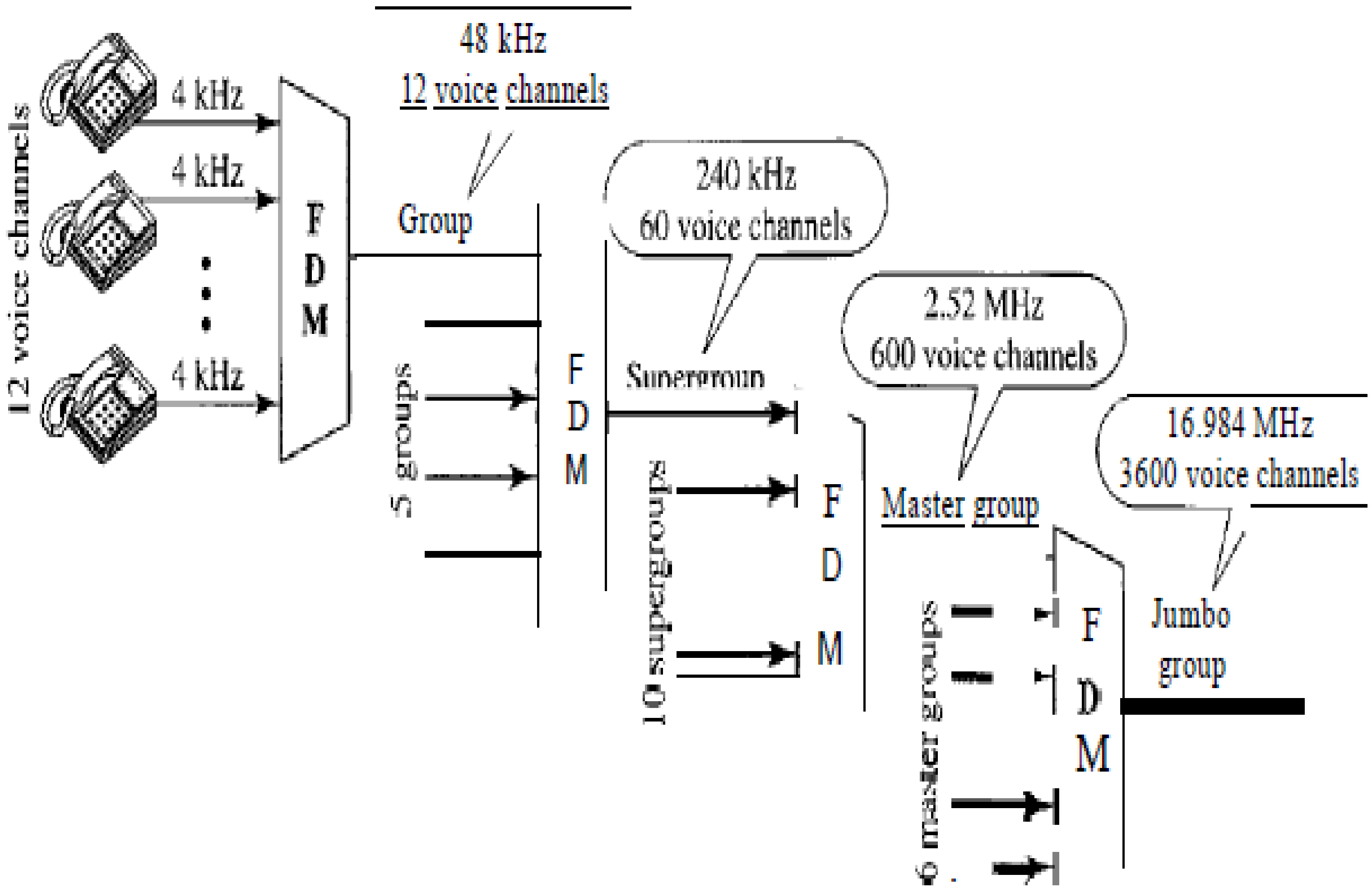
The satellite channel is analog. We divide it into four channels, each channel having a 250-kHz bandwidth. Each digital channel of 1 Mbps is modulated .

Example 3


I Mbps
250 kHz
Digital
Analog
I Mbps
250 kHz
Digital
Analog
I Mbps
250 kHz
Digital
Analog
I Mbps
250 kHz
Digital
Analog
FDM
I MHz

The Analog Carrier System: To maximize the efficiency of their infrastructure, telephone companies have traditionally multiplexed signals from lower-bandwidth lines onto higher-bandwidth lines. In this way, many switched or leased lines can be combined into fewer but bigger channels. For analog lines, FDM is used.

Analog hierarchy



One of these hierarchical systems used by AT&T is made up of groups, supergroups, master groups, and jumbo groups. In this analog hierarchy, 12 voice channels are multiplexed onto a higher-bandwidth line to create a group. A group has 48 kHz of bandwidth and supports 12 voice channels.

At the next level, up to five groups can be multiplexed to create a composite signal called a supergroup. A supergroup has a bandwidth of 240 kHz and supports up to 60 voice channels. Supergroups can be made up of either five groups or 60 independent voice channels.

At the next level, 10 supergroups are multiplexed to create a master group. A master group must have 2.40 MHz of bandwidth, but the need for guard bands between the supergroups increases the necessary bandwidth to 2.52 MHz. Master groups support up to 600 voice channels.

Finally, six master groups can be combined into a jumbo group. A jumbo group must have 15.12 MHz (6 x 2.52 MHz) but is augmented to 16.984 MHz to allow for guard bands between the master groups.