What are Network Devices?

Definition: The devices which are used for communication between different hardware used in the computer network are known as network devices. These devices are also known as physical devices, networking hardware, and network equipment otherwise computer networking devices.

Network devices are physical devices that enable communication and interaction between hardware on a computer network.

Hub

Hubs connect multiple computer networking devices together. A hub also acts as a repeater in that sense signals deteriorate after traveling long distances over connecting cables. A hub is the simplest in the family of network connecting devices because it connects LAN components with identical protocols.

Hubs do not perform packet filtering or addressing functions; they just send data packets to all connected devices. Hubs operate at the Physical layer of the Open Systems Interconnection (OSI) model.

Switch

Switches generally have a more intelligent role than hubs. A switch is a multiport device that improves network efficiency and it allows connections to systems like hubs or routers. Networks of LANs are usually connected using switches. Generally, switches can read the hardware addresses of incoming packets to transmit them to the appropriate destination.

Routers

A router is a network device similar to a switch that routes data packets based on their IP addresses . The router is primarily a Network Layer device. A router is also known as an intelligent device because it can automatically calculate the best route to pass network packets from source to destination. A router examines a data packet's destination IP address and uses headers and forwarding tables to determine the best way to transfer the packets.

Bridge

A bridge is a network device that operates at the data link layer device. A bridge is a repeater with the added functionality of filtering content by reading the MAC addresses of the source and destination. It is also used to connect two LANs that use the same protocol. It has a single input and output port, making it a two-port device.

Gateway

A gateway is a network node in telecommunications that connects two networks that use different transmission protocols. Gateways serve as network entry and exit points because all data must pass through or communicate with the gateway before being routed.

A modem is a network device that modulates and demodulates analog carrier signals (known as sine waves) to encode and decode digital data for processing. Because modems perform both of these tasks simultaneously, the term modem is a combination of "modulate" and "demodulate".

Repeaters

A repeater is a two-port device that operates at the physical layer . It is used to regenerate the signal over the same network before it becomes too weak or corrupted, allowing the signal to be transmitted for a longer distance over the same network. It is important to understand that repeaters do not amplify the signal.

When the signal weakens, repeaters copy it bit by bit and regenerate it at its original strength.

WHAT IS A BRIDGE?

In the physical world, a bridge connects roads on separate sides of a river or railroad tracks. In the technical world, bridges connect two physical network segments. Each network bridge keeps track of the MAC addresses on the network attached to each of its interfaces. When network traffic arrives at the bridge and its target address is local to that side of the bridge, the bridge filters that Ethernet frame, so it stays on the local side of the bridge only.

If the bridge is unable to find the target address on the side that received the traffic, it forwards the frame across the bridge, hoping the destination will be on the other network segment. At times, there are multiple bridges to cross to get to the destination system.

NIC

Network Interface Card (NIC) The network interface card (NIC), as its name suggests, is the expansion card you install in your computer to connect, or interface, your computer to the network. This device provides the physical, electrical, and electronic connections to the network media. A NIC is either an expansion card (the most popular implementation) or built into the motherboard of the computer.

Modems

A modem, short for modulator/demodulator, is a device that converts the digital signals generated by a computer into analog signals that can travel over conventional phone lines. The modem at the receiving end converts the signal back into a format the computer can understand. Modems can be used as a means to connect to an ISP or as a mechanism for dialing up to a LAN.

What is a MAC Address?

A Media Access Control (MAC) address is a string of characters that identifies a device on a network. It's tied to a key connection device in your computer called the network interface card, or NIC. The NIC is essentially a computer circuit card that makes it possible for your computer to connect to a network. A NIC turns data into an electrical signal that can be transmitted over the network.

A MAC (Media Access Control) address, sometimes referred to as a **hardware** or **physical** address, is a unique, 12-character alphanumeric attribute that is used to identify individual electronic devices on a network. An example of a MAC address is: 00-B0-D0-63-C2-26.

What is the IPv4 Address?

An IP address uniquely identifies each host and network. This IP address is 32 bits long.

One of the usual IP addresses that we see.

For example, 145.10.34.3.

This address is a 32-bit address represented within the system in binary form:

10010001.00001010.00100010.00000011

An IP address format is usually divided into two parts:

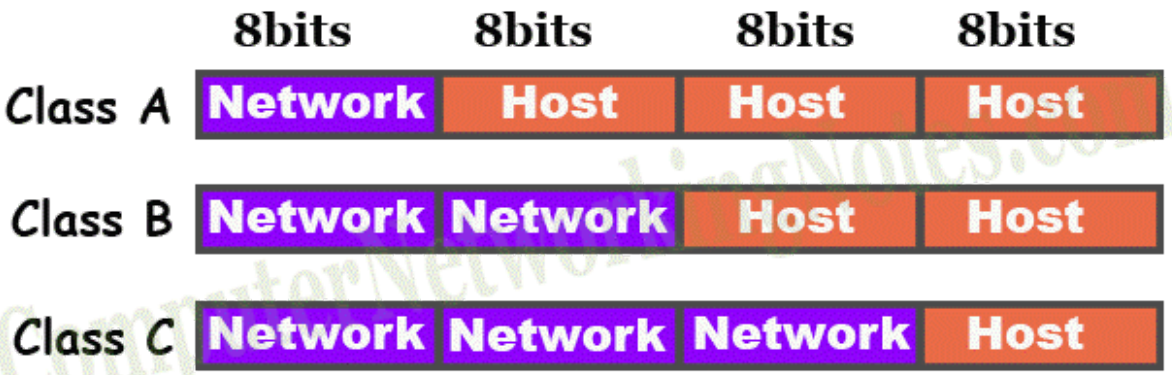
- ***Network ID:** To uniquely identify the network to which the host belongs.*
- ***Host ID:** To uniquely identify the host in a particular network.*

Two hosts in the same network have the same network ID part but different host ID part.

Different Classes of IP Address

Following are the different classes of IP address:

1. *Class A*
2. *Class B*
3. *Class C*
4. *Class D*
5. *Class E*



Class A

- This Class IP address always has its first bit as 0, next 7 bits as a network address and following 24 bits as the host address.
- The range of IP addresses is 0.0.0.0 to 127.255.255.255.
- This means that it allows 2^7 networks and 2^24 hosts per network.
- This class of IP address is used for a very large network. Ex. Big Organization

Class B

- Class B IP address always has its first bits as 10, next 14 bits as a network address and following 16 bits as the host address.
- The range of IP addresses is 128.0.0.0 to 191.255.255.255.
- This means that it allows 2^14 networks and 2^16 hosts per network.
- This class of IP address is used for a medium network like multinational companies.

Class C

- Class C IP address always has its first bits as 110, next 21 bits as a network address and following 8 bits as the host address.
- The range of IP addresses is the first block from 192.0.0.0 to 192.0.0.255 and the last block from 223.255.255.0 to 223.255.255.255.
- This means that it allows 2^21 networks and 2^8 hosts per network.
- This class is used for a small network such as small companies or colleges.

Class D

- Class D IP address always has its first bits as 1110.
- There is no segregation of host and network addresses.
- It allows **multicast** which means a datagram directed to multiple hosts.

Class E

- The address begins with 1111.
- It is reserved for **future use, research, and development purposes**.

Class	Leading bits	Size of *network number* bit field	Size of *rest* bit field	Number of networks	Addresses per network	Total addresses in class	Start address	End address
Class A	0	8	24	128 (2^7)	16,777,216 (2^{24})	2,147,483,648 (2^{31})	0.0.0.0	127.255.255.255
Class B	10	16	16	16,384 (2^{14})	65,536 (2^{16})	1,073,741,824 (2^{30})	128.0.0.0	191.255.255.255
Class C	110	24	8	2,097,152 (2^{21})	256 (2^8)	536,870,912 (2^{29})	192.0.0.0	223.255.255.255
Class D (multicast)	1110	not defined	not defined	not defined	not defined	268,435,456 (2^{28})	224.0.0.0	239.255.255.255
Class E (reserved)	1111	not defined	not defined	not defined	not defined	268,435,456 (2^{28})	240.0.0.0	255.255.255.255

Identifying the class of an IP address (decimal notation)

If an IP address is written in the decimal notation, check the value of the first section or octet and use the following rules to identify the class of the IP address.

- If the value is in the range **1** to **127**, the address belongs to class **A**.
- If the value is in the range **128** to **191**, the address belongs to class **B**.
- If the value is in the range **192** to **223**, the address belongs to class **C**.
- If the value is in the range **224** to **239**, the address belongs to class **D**.
- If the value is in the range **240** to **255**, the address belongs to class **E**.

Identifying the class of an IP address (binary notation)

If an IP address is written in the binary notation, you can use the following rules to identify the class of the IP address.

- If the first bit is **OFF**, the address belongs to class **A**.

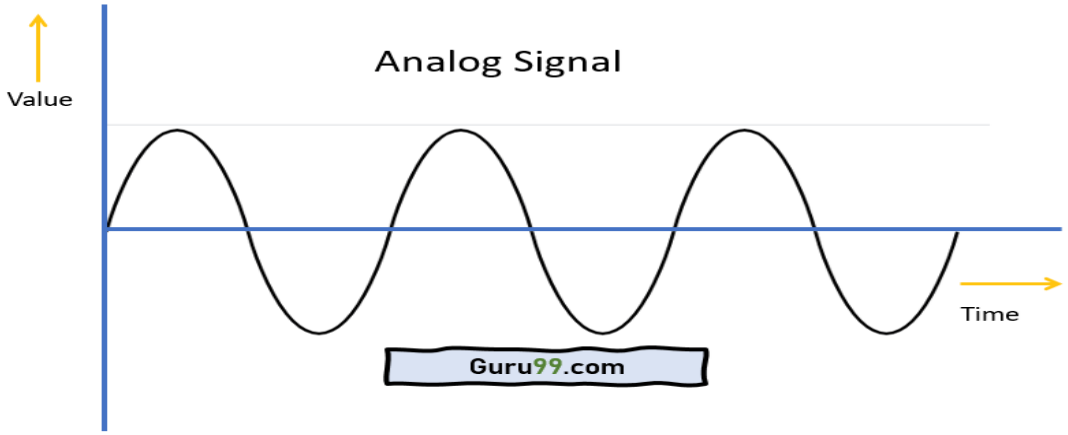
- If the first bit is **ON** and the second bit is **OFF**, the address belongs to class **B**.
- If the first two bits are **ON** and the third bit is **OFF**, the address belongs to class **C**.
- If the first three bits are **ON** and the fourth bit is **OFF**, the address belongs to class **D**.
- If the first four bits are **ON**, the address belongs to class **E**.

What is Signal?

A signal is an electromagnetic or electrical current that is used for carrying data from one system or network to another. The signal is a function that conveys information about a phenomenon.

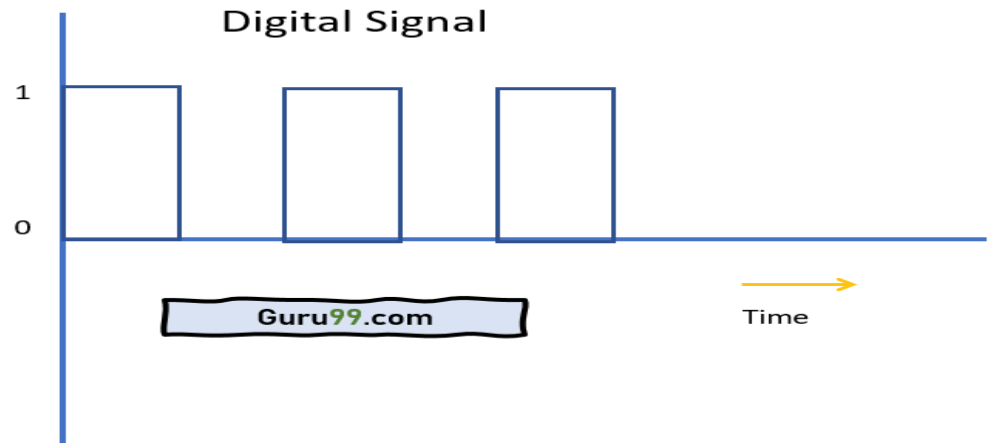
Analog signal

Analog signal is a continuous signal in which one time-varying quantity represents another time-based variable. These kinds of signals work with physical values and natural phenomena such as earthquake, frequency, volcano, speed of wind, weight, lighting, etc.



What is a Digital Signal?

A digital signal is a signal that represents data as a sequence of discrete values. A digital signal can only take on one value from a finite set of possible values at a given time.



Difference Between Analog And Digital Signal

Analog Signals	Digital Signals
Continuous signals	Discrete signals
Represented by sine waves	Represented by square waves
Human voice, natural sound, analog electronic devices are a few examples	Computers, optical drives, and other electronic devices

Continuous range of values	Discontinuous values
Records sound waves as they are	Converts into a binary waveform.
Only used in analog devices.	Suited for digital electronics like computers, mobiles and more.

Modulation

It is very important to modulate the signals before sending them to the receiver section for larger distance transfer, accurate data transfer, and low-noise data reception.

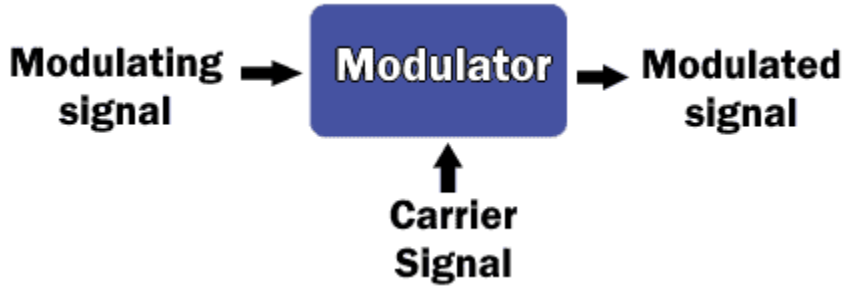
Two signals are involved in the modulation process. Message signals also known as baseband signals. Baseband signals are the band of frequencies representing the original signal. This is the signal to be transmitted to the receiver. The frequency of such a signal is usually low. The other signal involved with this is a high-frequency sinusoidal wave. This signal is called the carrier signal. The frequency of the carrier signals is almost always higher than that of the baseband signal.

Therefore, modulation can be defined as,

The process of superimposing a low-frequency signal on a high-frequency carrier signal.

Or

The process of varying any of the three characteristics as the Amplitude, Frequency or the Phase of a carrier signal is called as modulation



Types of Modulation

Basically, the modulation is classified into two types: analog modulation and digital modulation.

Analog modulation

In analog modulation, the analog signal (sinusoidal signal) is used as a carrier signal that modulates the analog message signal. In analog modulation, the characteristics (amplitude, frequency or phase) of the carrier signal is varied in accordance with the amplitude of the message signal.

There are 3 basic types of analog modulation: Amplitude modulation, Frequency modulation, and Phase modulation.

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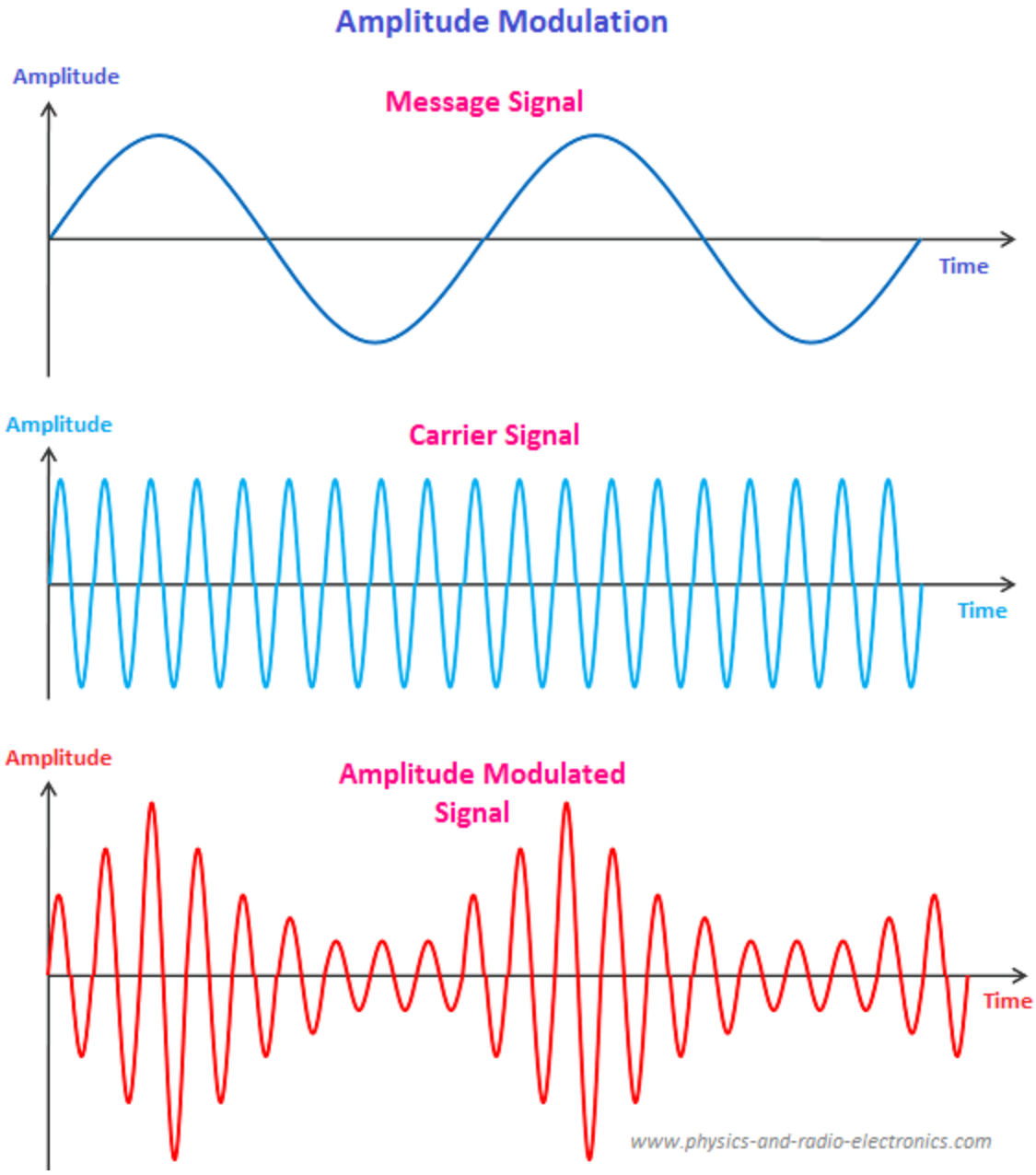
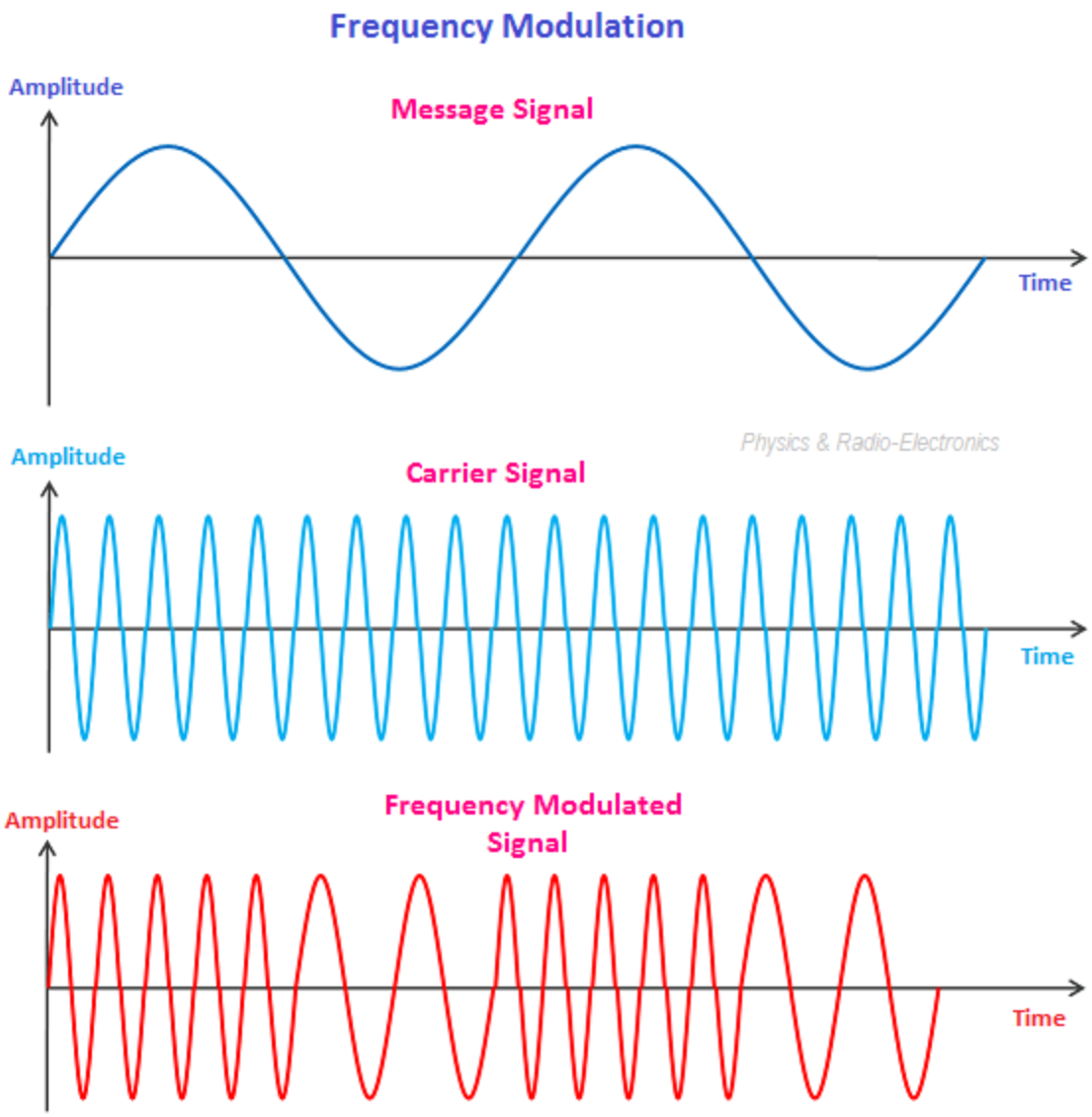
amplitude modulation

> Amplitude modulation is a type of modulation where the amplitude of the carrier signal is varied (changed) in accordance with the amplitude of the message signal while the frequency and phase of the carrier signal remain constant.



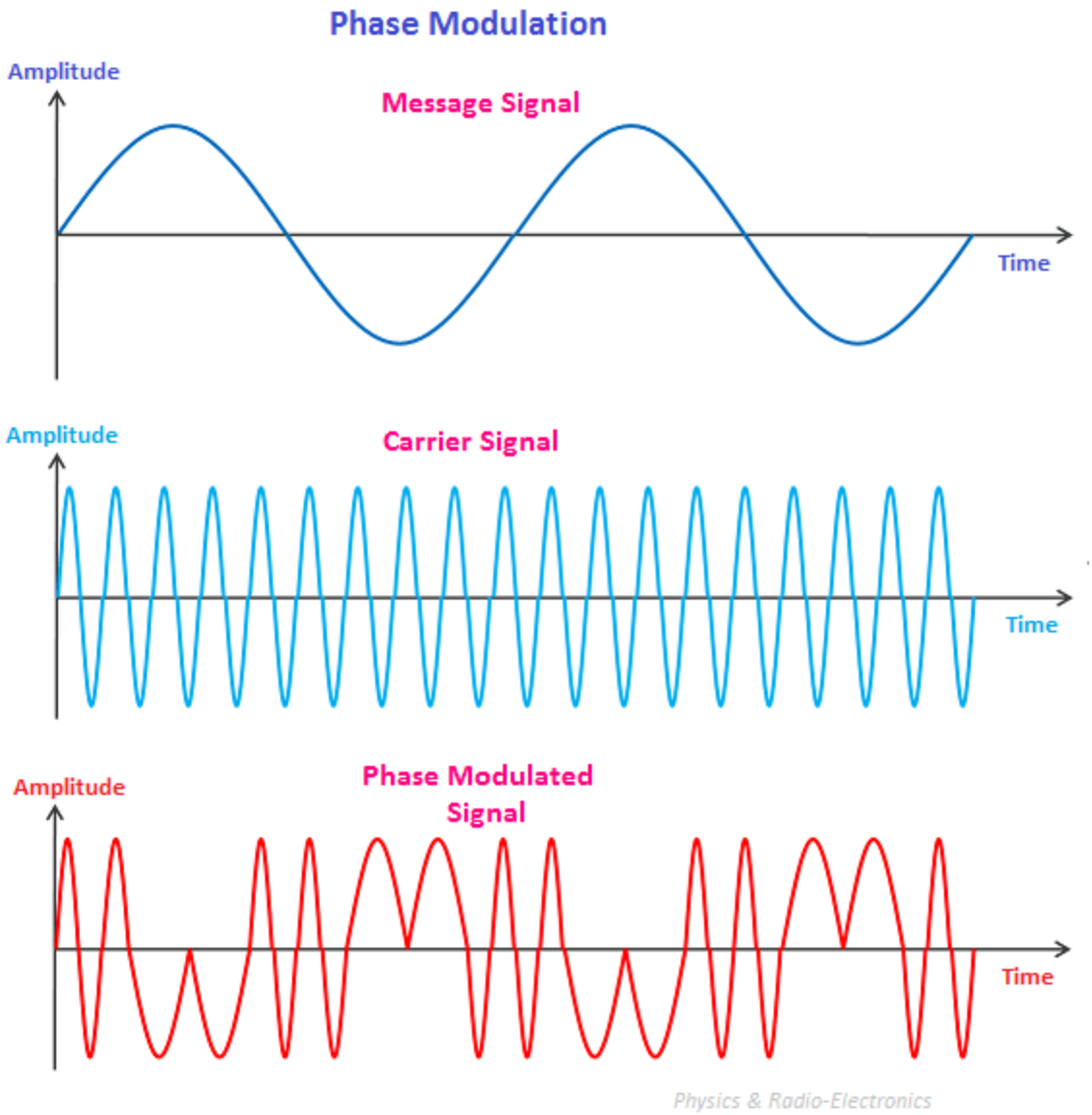
frequency modulation

Frequency modulation is a type of modulation where the frequency of the carrier signal is varied (changed) in accordance with the amplitude of the message signal while the amplitude and phase of the carrier signal remain constant.



phase modulation

Phase modulation is a type of modulation where the phase of the carrier signal is varied (changed) in accordance with the amplitude of the message signal while the amplitude of the carrier signal remains constant.


Phase Modulation
Amplitude
Message Signal
Time
Amplitude
Carrier Signal
Time
Amplitude
Phase Modulated
Signal
Time
Physics & Radio-Electronics