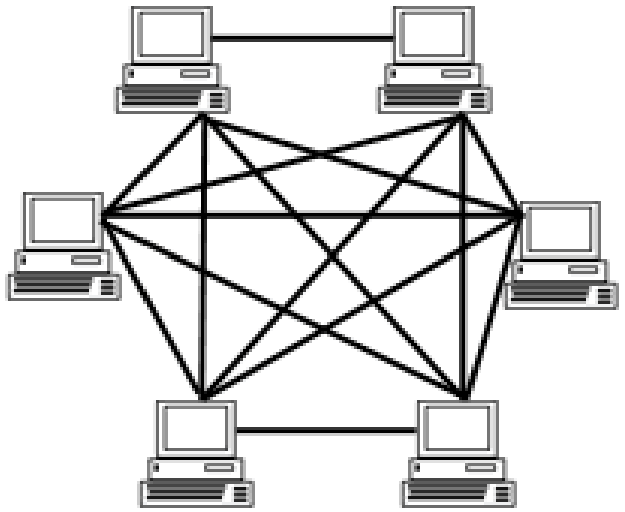
Mesh Topology



Mesh topology is a type of networking where all nodes cooperate to distribute data amongst each other.

Advantages of mesh topology:

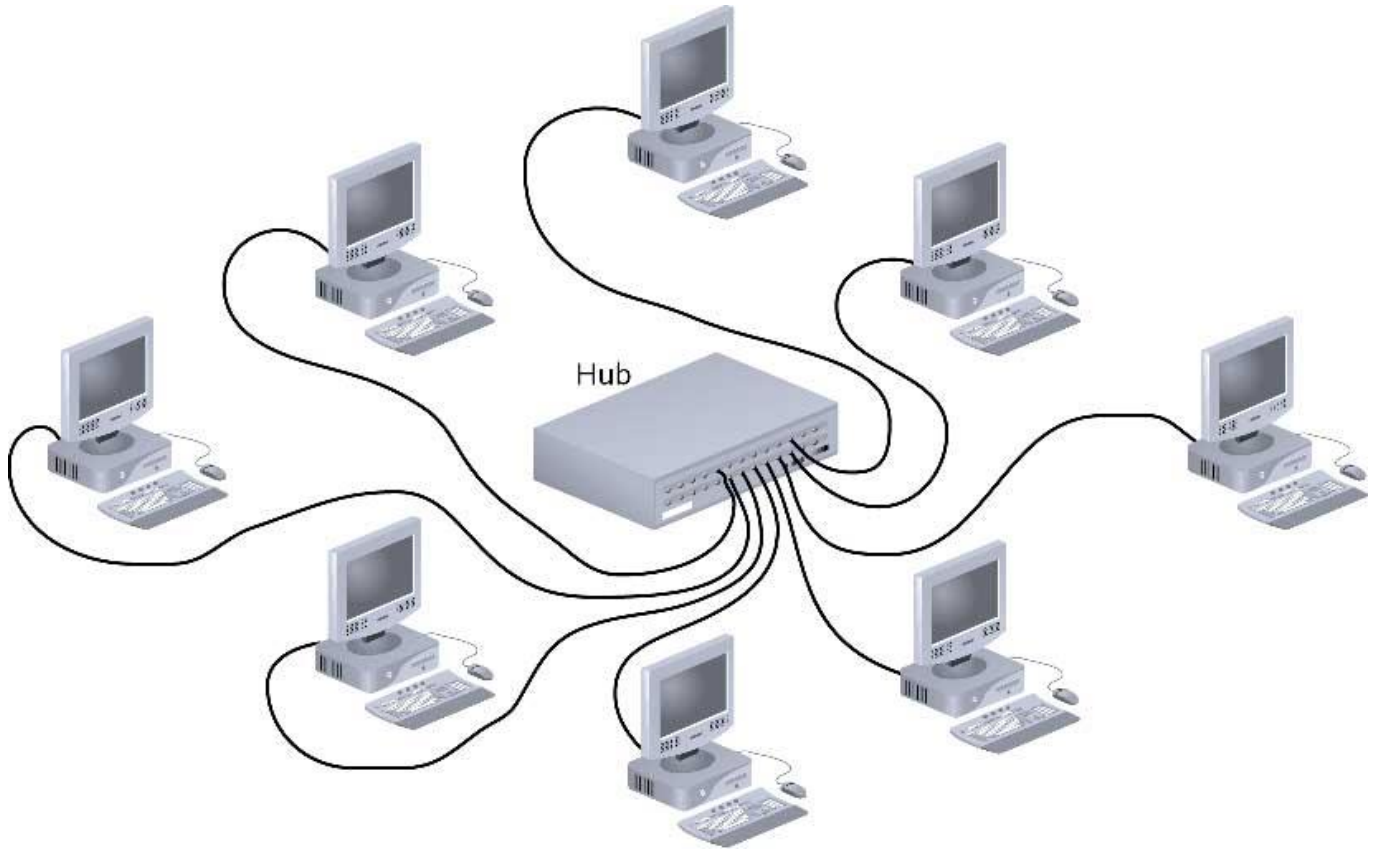
- Each connection can carry its own data load
- It is robust
- A fault is diagnosed easily
- Provides security and privacy

Disadvantages of mesh topology:

- Installation and configuration are difficult if the connectivity gets more
- Cabling cost is more and the most in case of a fully connected mesh topology
- Bulk wiring is required

Star Topology

Every node on the network is connected through a central device



Star (continued)

- Any single cable connects only two devices
  - Cabling problems affect two nodes at most
- Requires more cabling than ring or bus networks
  - More fault-tolerant
- Easily moved, isolated, or interconnected with other networks
  - Scalable

Advantages & Disadvantages of Star Topology

Advantages

- Good option for modern networks
- Low startup costs
- Easy to manage
- Offers opportunities for expansion
- Most popular topology in use; wide variety of equipment available

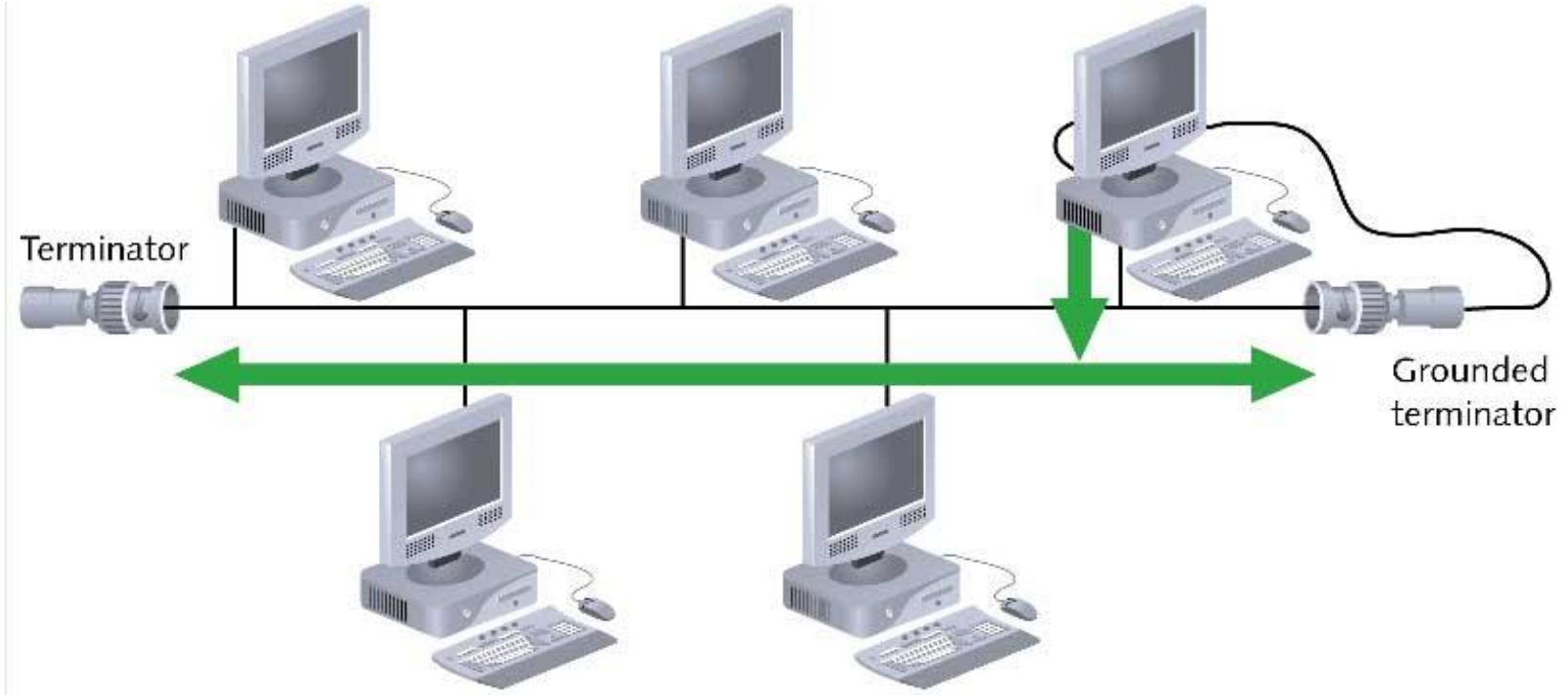
Disadvantages

- Hub is a single point of failure
- Requires more cable than the bus

Bus Topology

- Single cable connects all network nodes without intervening connectivity devices
- Devices share responsibility for getting data from one point to another
- Terminators stop signals after reaching end of wire
  - Prevent signal bounce
- Inexpensive, not very scalable
- Difficult to troubleshoot, not fault-tolerant

Bus Topology (continued)



Advantages & Disadvantages of Bus Topology

Advantages

- Works well for small networks
- Relatively inexpensive to implement
- Easy for adding new systems

Disadvantages

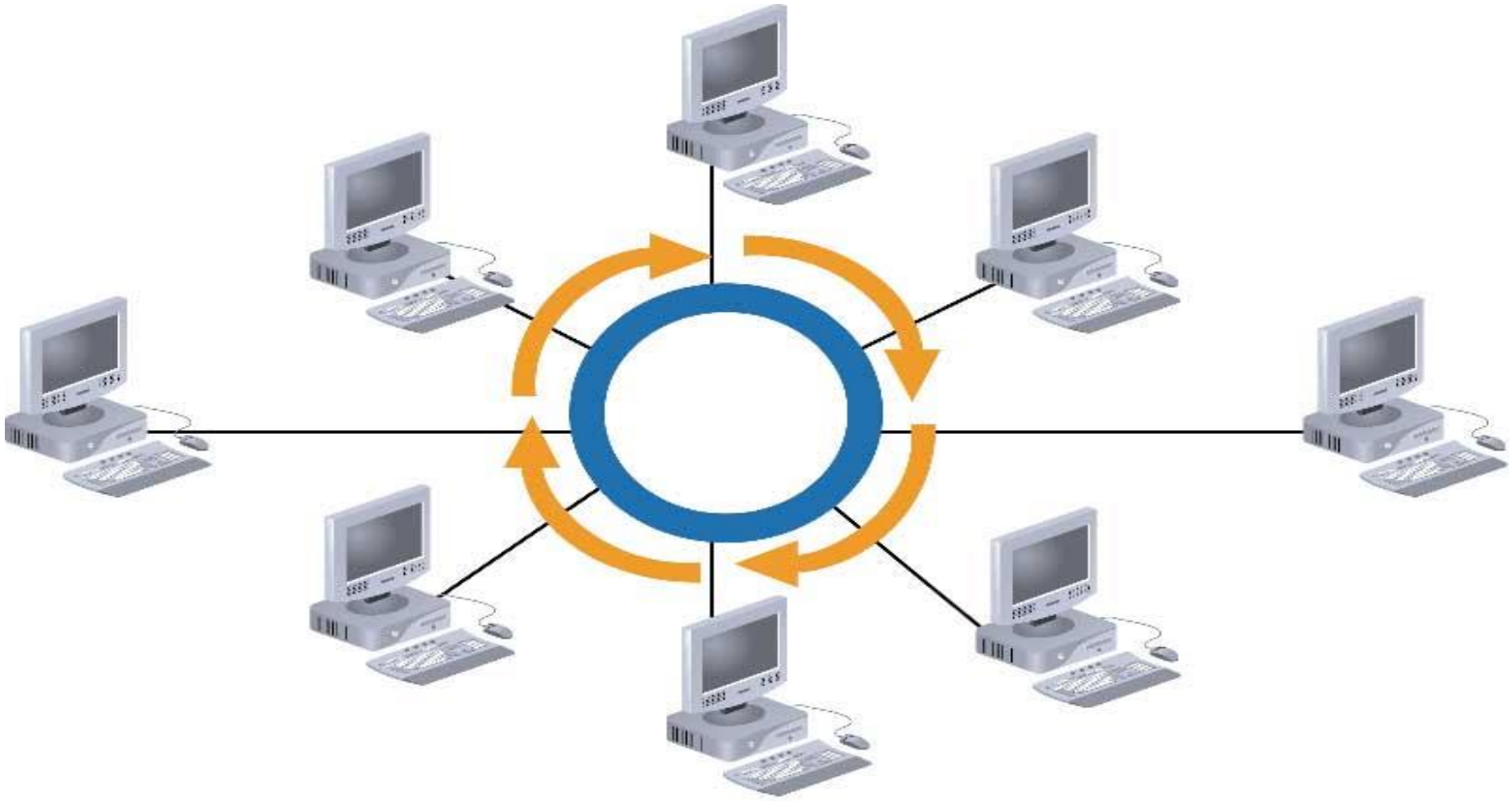
- Management costs can be high
- Potential for congestion with network traffic

Ring topology

- Each node is connected to the two nearest nodes so the entire network forms a circle
- One method for passing data on ring networks is **token passing**

Active topology

- Each workstation transmits data



Advantages of Ring Topology

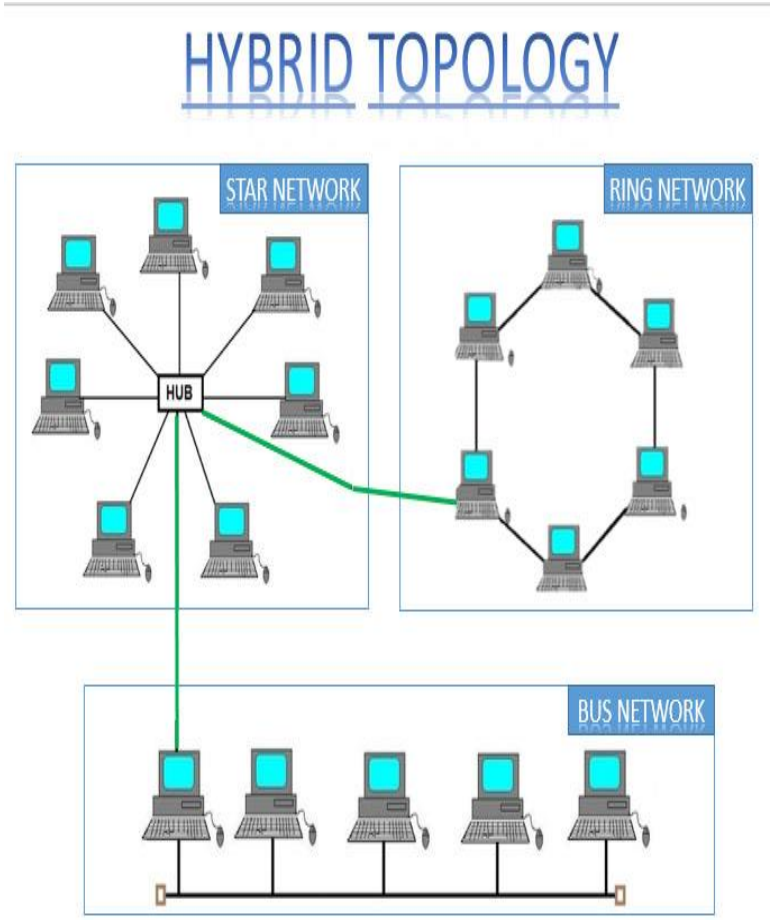
- Easier to manage; easier to locate a defective node or cable problem
- Well-suited for transmitting signals over long distances on a LAN
- Handles high-volume network traffic
- Enables reliable communication

Disadvantages of Ring Topology

- Expensive
- Requires more cable and network equipment at the start
- Not used as widely as bus topology
  - Fewer equipment options
  - Fewer options for expansion to high-speed communication

Derived Topology-HYBRID TOPOLOGY

A **hybrid topology** is a type of network topology that uses two or more other network topologies, including bus topology, mesh topology, ring topology, star topology, and tree topology.



Advantages of Hybrid Network Topology

1)**Reliable :** Unlike other networks, fault detection and troubleshooting is easy in this type of topology.

2) **Scalable:** Its easy to increase the size of network by adding new components, without disturbing existing architecture.

3) **Flexible:** Hybrid Network can be designed according to the requirement and by optimizing the available resources.

4) **Effective:** Hybrid topology is the combination of two or more topologies, so we can design in such a way that strengths of constituent topologies are maximized while there weaknesses are neutralized.

Disadvantages of Hybrid Topology

1) **Complexity of Design:** One of the biggest drawback of hybrid topology is its design. Its not easy to design this type of architecture and its a tough job for designers. Configuration and installation process needs to be very efficient.

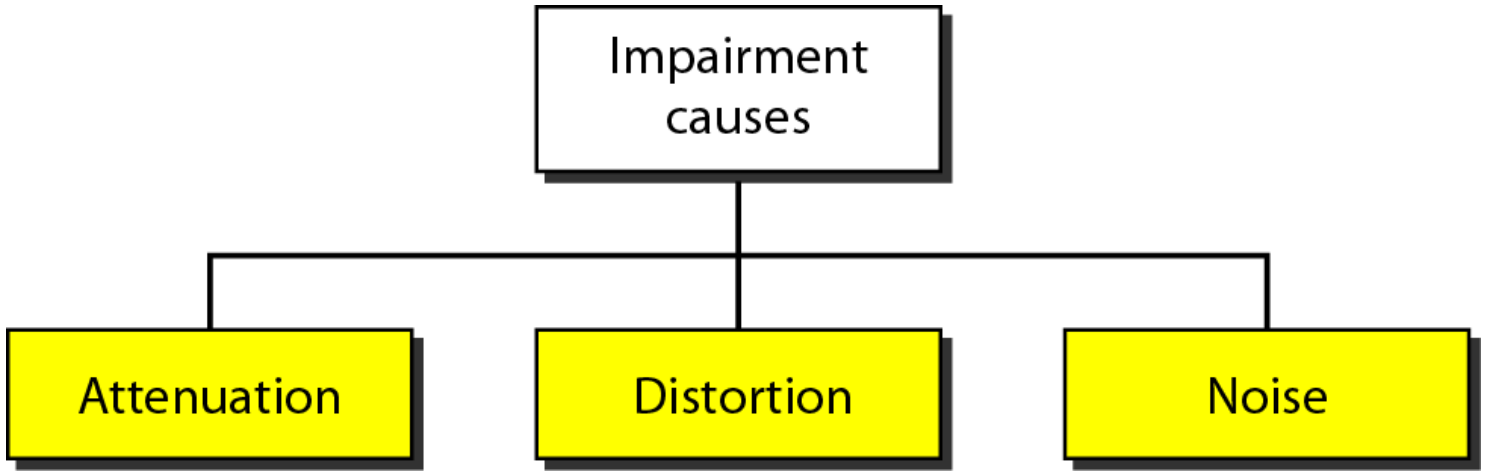
2) **Costly Switch :** The switches used to connect two distinct networks, are very expensive. These hubs are different from usual hubs as they need to be intelligent enough to work with different architectures and should be function even if a part of network is down.

3) **Costly Infrastructure:** As hybrid architectures are usually larger in scale, they require a lot of cables, cooling systems, sophisticate n/w devices, etc.

Transmission Impairment

TRANSMISSION IMPAIRMENT

Signals travel through transmission media, which are not perfect. The imperfection causes signal impairment. This means that the signal at the beginning of the medium is not the same as the signal at the end of the medium. What is sent is not what is received. Three causes of impairment are attenuation, distortion, and noise.



Attenuation

- Means loss of energy -> weaker signal
- When a signal travels through a medium it loses energy overcoming the resistance of the medium
- Amplifiers are used to compensate for this loss of energy by amplifying the signal.

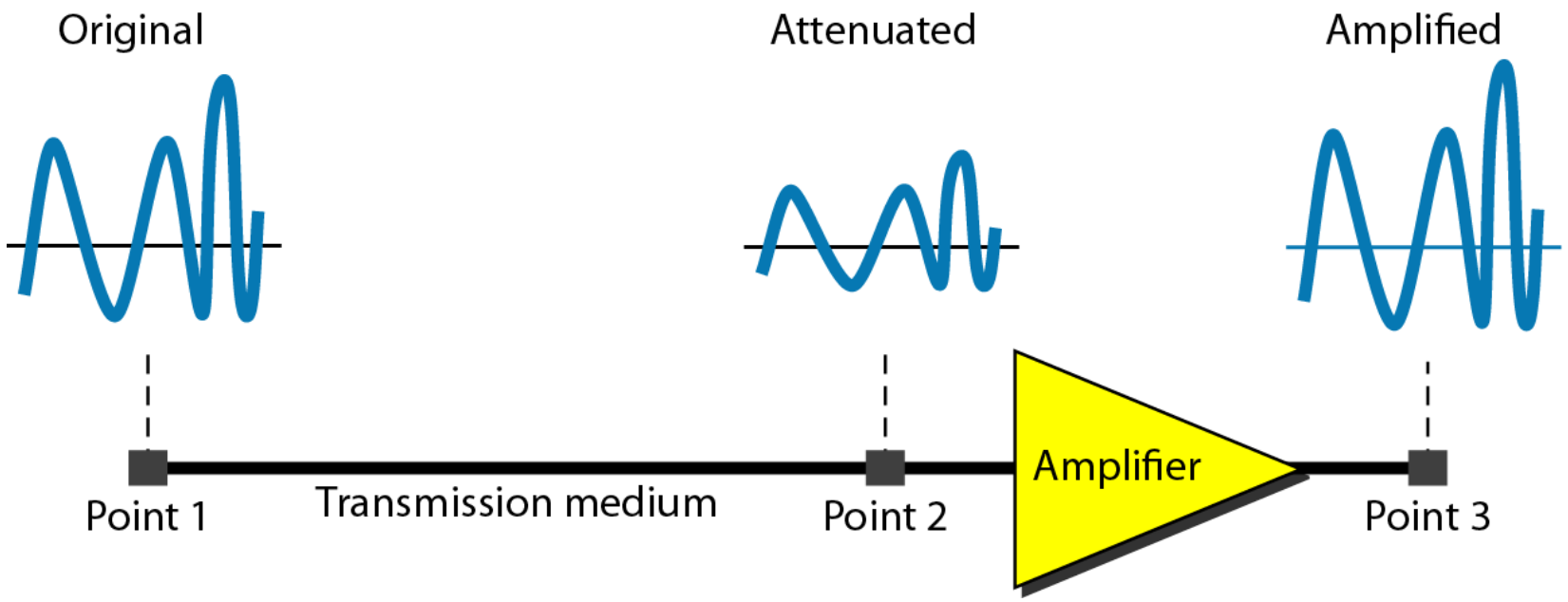
- To show the loss or gain of energy the unit “decibel” is used.

$$dB = 10 \log_{10} P_2/P_1$$

P_1 - input signal

P_2 - output signal

Attenuation



Example

Suppose a signal travels through a transmission medium and its power is reduced to one-half. This means that P2 is P1 / 2. In this case, the attenuation (loss of power) can be calculated as

$$10 \log_{10} \frac{P_2}{P_1} = 10 \log_{10} \frac{0.5 P_1}{P_1} = 10 \log_{10} 0.5 = 10(-0.3) = -3 \text{ dB}$$

A loss of 3 dB (–3 dB) is equivalent to losing one-half the power.

Example

The loss in a cable is usually defined in decibels per kilometer (dB/km). If the signal at the beginning of a cable with −0.3 dB/km has a power of 2 mW, what is the power of the signal at 5 km?

Solution

The loss in 5 km cable in decibels is 5 × (−0.3) = −1.5 dB.

P_1=2mW

We can calculate

$$\text{dB} = 10 \log_{10} \frac{P_2}{P_1} = -1.5$$

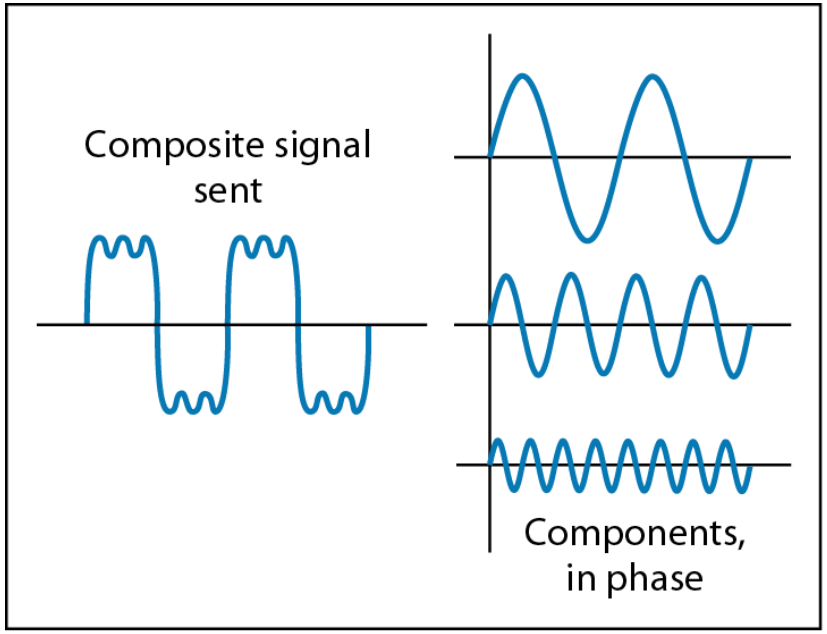
$$\frac{P_2}{P_1} = 10^{-0.15} = 0.71$$

$$P_2 = 0.71 P_1 = 0.7 \times 2 = 1.4 \text{ mW}$$

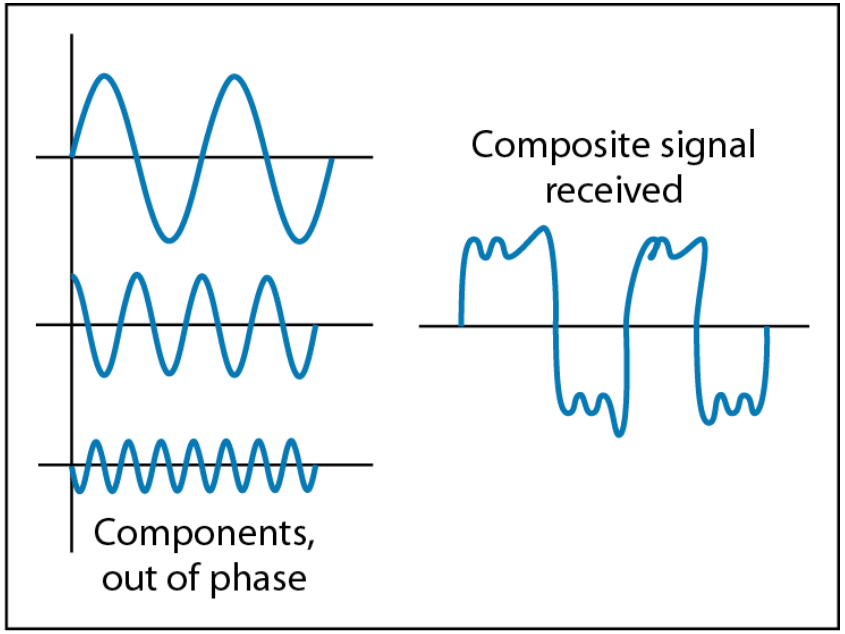
Distortion

- Means that the signal changes its form or shape
- Distortion occurs in composite signals
- Each frequency component has its own propagation speed traveling through a medium.
- The different components therefore arrive with different delays at the receiver.
- That means that the signals have different phases at the receiver than they did at the source.

Distortion



At the sender

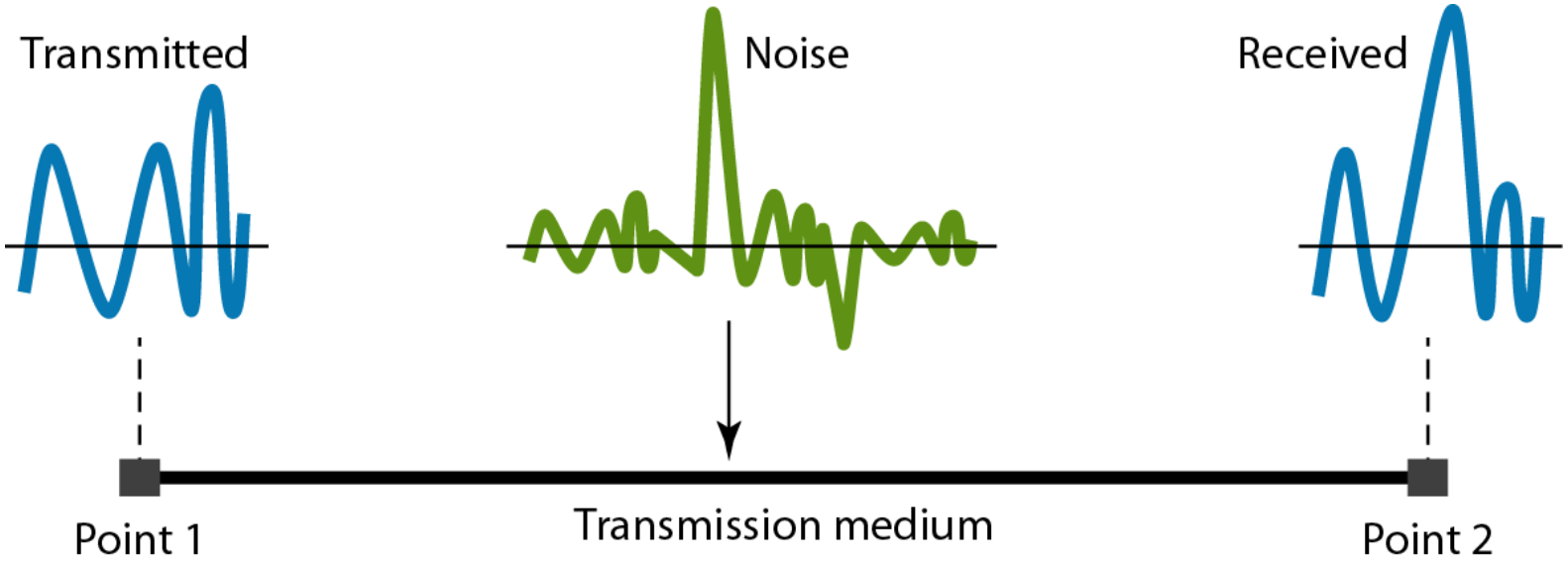


At the receiver

Noise

- There are different types of noise
  - Thermal - random noise of electrons in the wire creates an extra signal
  - Induced - from motors and appliances, devices act are transmitter antenna and medium as receiving antenna.
  - Crosstalk - same as above but between two wires.
  - Impulse - Spikes that result from power lines, lightning, etc.

Noise


Transmitted
Noise
Received
Point 1
Transmission medium
Point 2

Noise

→ The signal-to-noise ratio is defined as

$$SNR = \frac{\text{average signal power}}{\text{average noise power}}$$

$$\boxed{SNR_{dB} = 10 \log_{10} SNR}$$

Ques. The power of a signal is 10mW and the power of the noise is 1 μW. what are the values of SNR and SNR_{dB}?

Soln.

$$SNR = \frac{10mW}{1\mu W} = \frac{10^{-2}W}{10^{-6}W} = 10^4 = 10000.$$

$$SNR_{dB} = 10 \log_{10} SNR$$

$$= 10 \log_{10} 10000 = 10 \log_{10} 10^4$$

$$= 4 \times 10 \log_{10} 10 = 40$$