Course Title

Advanced Wireless Communication

Dr. Md Habibur Rahman
Professor
Dept. of Computer Science and Engineering
Faculty of Engineering and Technology
Islamic University, Bangladesh, Kushtia-7003
Email: habibiucse@gmail.com

Course Code: CSE 5114

Course Title: Advanced Wireless Communication

Distribution	Marks
Class attendance	10
In-course/tutorial exam/ assignment	30
Semester-Final Exam	60
Total	100

WHAT IS WIRELESS Communication?

Wireless communication is the transfer of information between two or more devices without using a physical cable.

No cable needed

Uses EM waves

Works over air or space

What type of information can be sent?

Wireless communication can carry many forms of data.

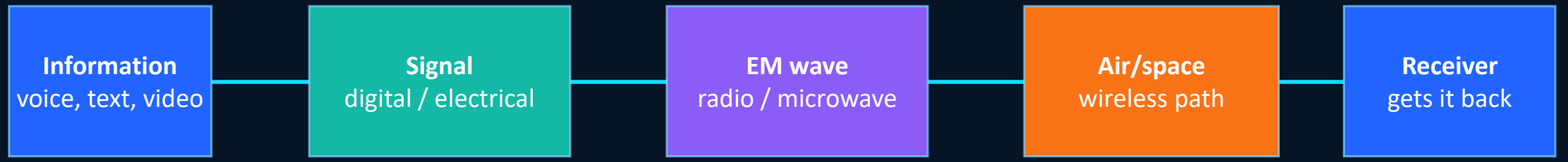
- Voice
  phone call
- Text
  message
- Images
  photos
- Video
  streaming
- Internet
  data

The device first changes this information into an electrical or digital signal.

Example: your voice becomes a digital signal before it can be transmitted from a phone.

Basic process

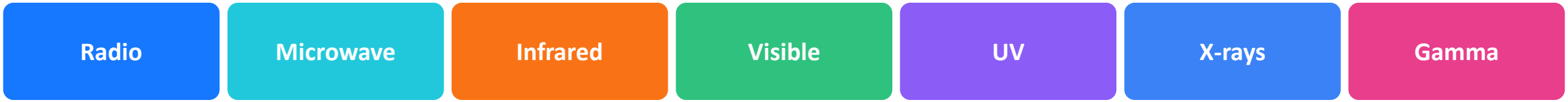
The sender changes information into a wave, and the receiver changes it back.



This is the main idea behind mobile calls, Wi-Fi, Bluetooth, radio and satellite communication.

The spectrum in order

From radio waves to gamma rays, energy increases from left to right.



Radio waves, microwaves and infrared

These lower-energy parts are the most important for wireless communication.

Radio waves

Longest wavelength. Used for AM/FM radio, TV broadcasting and long-distance wireless communication. They can travel far and bend around some obstacles.

Microwaves

Shorter wavelength than radio waves. Used for Wi-Fi, mobile networks, radar, GPS and satellite links. They can carry more data but are more affected by obstacles.

Infrared

Often felt as heat. Used in TV remotes, thermal cameras and short-range communication. It usually needs a clear path between sender and receiver.

Visible light, UV, X-rays and gamma rays

These waves have shorter wavelength and higher energy.

Visible light

The only part our eyes can see. Used in cameras, optical fibre and Li-Fi research.

Ultraviolet

Invisible and more energetic than visible light. Used for disinfection and detecting marks.

X-rays

Can pass through soft tissue, so they are used in medical imaging and security scanning.

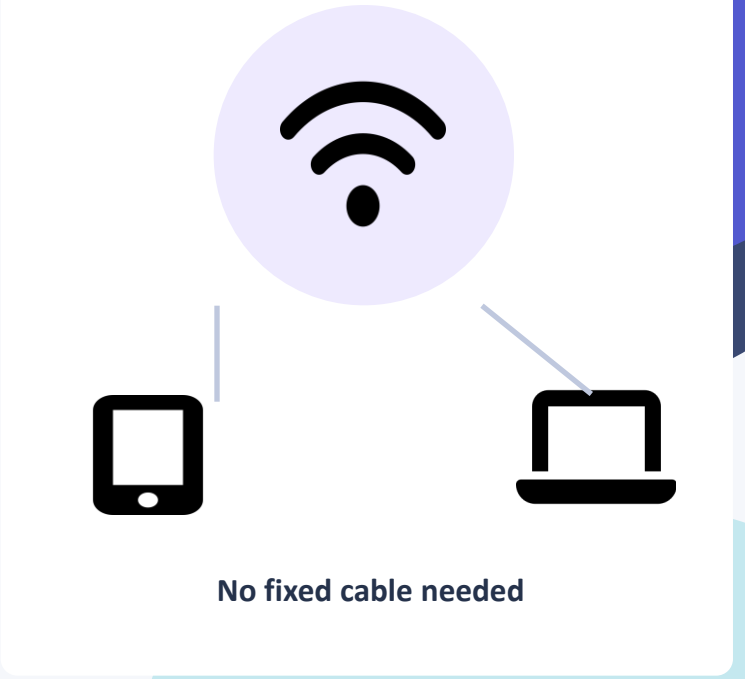
Gamma rays

Highest energy. Used in cancer treatment, sterilising equipment and scientific research.

Why Wireless Communication Matters

Freedom • Coverage • Connection • Flexibility

Wireless networks allow people and devices to communicate without a fixed physical cable connection.



BENEFIT 1

Freedom from wires

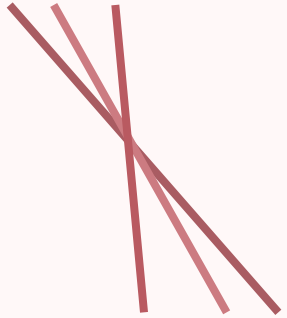
Wireless communication removes the need to install a physical cable for every connection.

WIRED

More setup

Install cables

Rewire when things move



WIRELESS

Connect quickly

Wi-Fi connects devices through radio signals

Bluetooth pairs nearby devices without a cable

Result: less installation cost, less cable clutter, and faster setup.

BENEFIT 2

Global coverage

Wireless communication can reach places where cables are difficult, expensive, or impossible to install.

Rural areas

Wireless links can serve communities without extensive cable infrastructure.

Old buildings

Wireless avoids difficult or disruptive new cable installation.



Vehicles

Moving cars, ships, and aircraft can communicate while in motion.

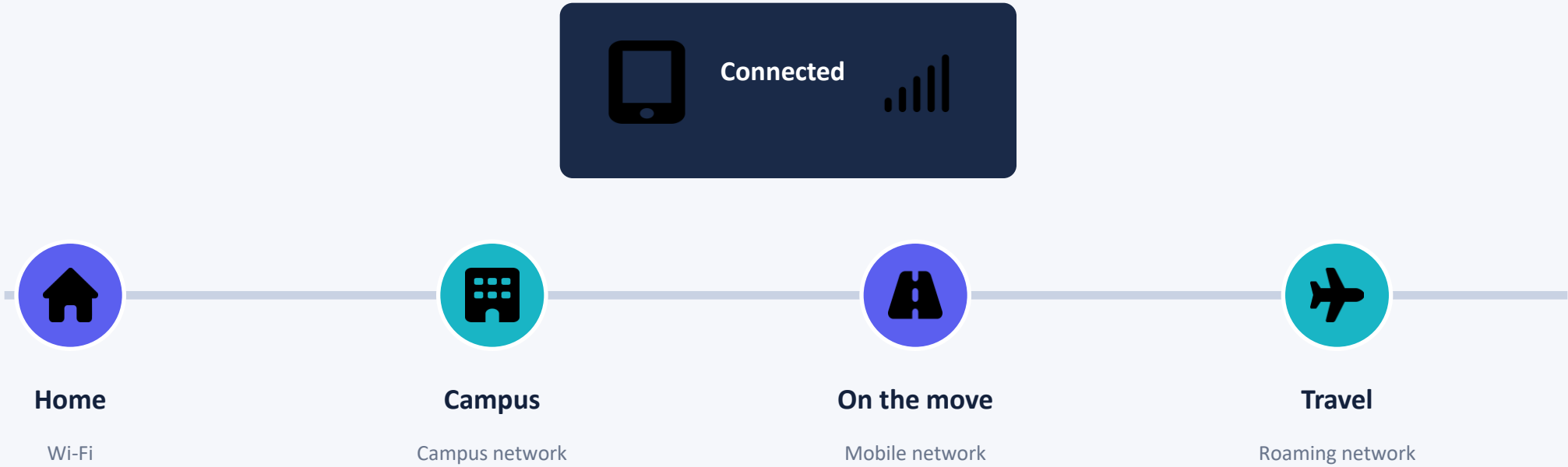
Outer space

Satellites extend communication over huge distances.

BENEFIT 3

Stay connected through roaming

Roaming helps a mobile device keep service while the user changes location or network coverage area.



The key idea

Your communication can continue while your location changes.

Example: a phone can move from one coverage area to another and still maintain access to calls, messages, or data.

BENEFIT 4

Flexibility: services move with you

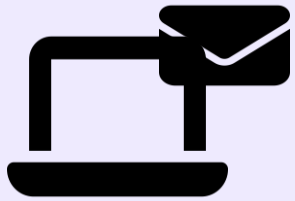
Mobility means you can access services from different places instead of being tied to one fixed workstation.

Home

Check email or online services.

Anywhere

Connect wherever coverage is available.



Your service

Campus

Use the same services from another location.

On the move

Stay productive while travelling.

You do not have to return to a specific lab or desk just to access a network service.

SUMMARY

Four reasons wireless communication is powerful

Wireless communication changes not only how devices connect, but also where and when people can use digital services.

01



Freedom from wires

Less cable installation, less clutter, and faster setup.

02



Global coverage

Useful where wiring is difficult, costly, or impossible.

03



Stay connected

Roaming supports connection while the user changes location.

04



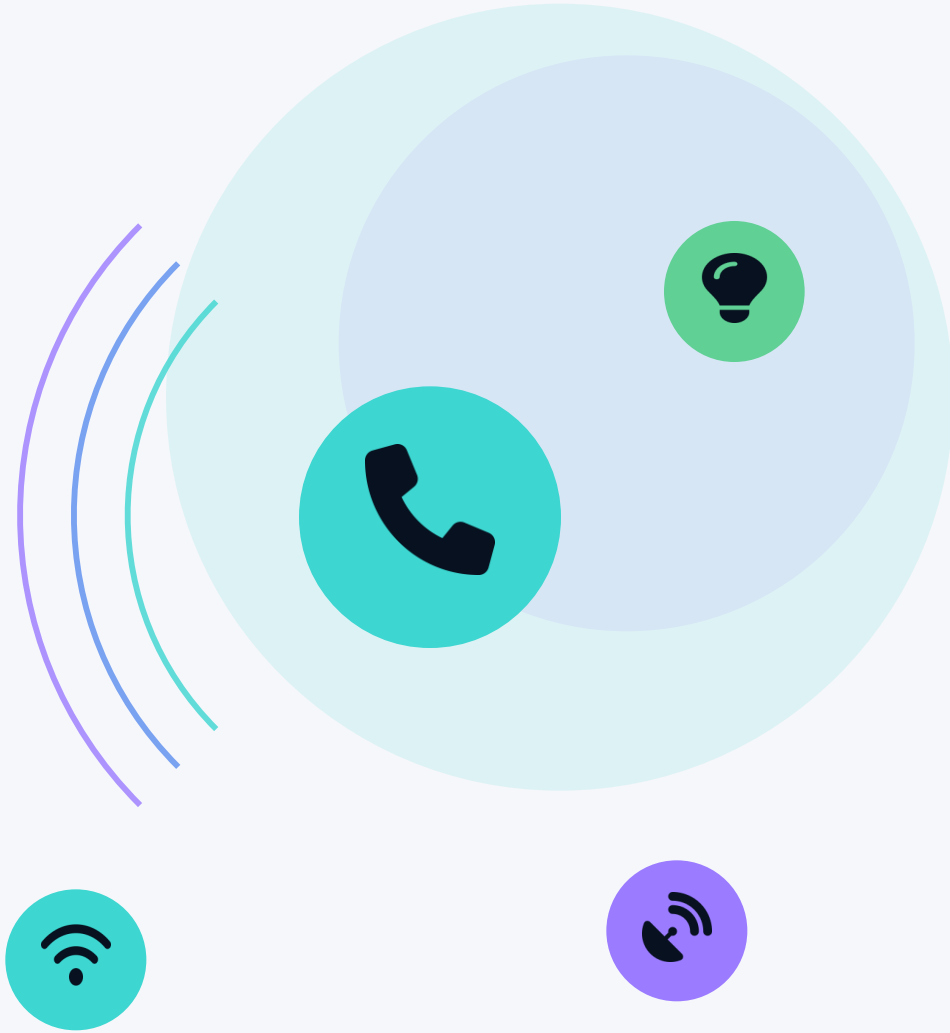
Flexibility

Services can be accessed from many places, not one fixed desk.

Main takeaway: wireless communication gives users more freedom of place, movement, and connection.

WIRELESS COMMUNICATION TECHNOLOGIES

From invisible infrared light to satellites in space — six ways our devices communicate without wires.



IR	Bluetooth	Wi-Fi
4G / 5G	Satellite	Li-Fi

Six technologies. Different signals. Different jobs.

The best technology depends on distance, speed, obstacles, and coverage.



Infrared

Light • Very short

Remote control



Bluetooth

Radio • Short

Accessories



Wi-Fi

Radio • Local

Internet / LAN



4G / 5G

Radio • Wide area

Mobile service



Satellite

Radio • Global

Long-distance links



Li-Fi

Visible light • Room-scale

High-speed data

01

Infrared (IR)

Short-distance communication using infrared light

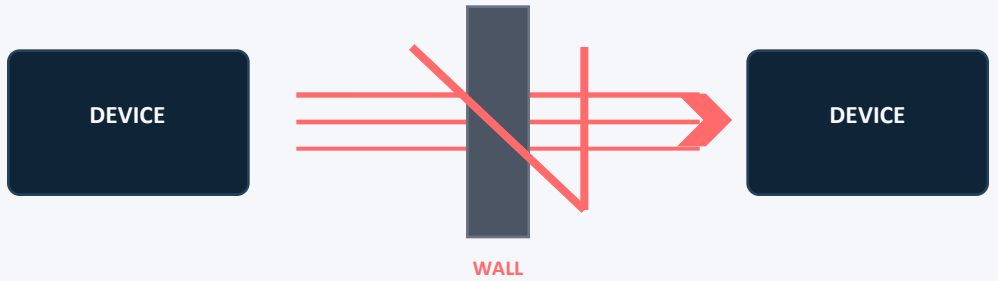
HOW IT WORKS

IR sends data using invisible infrared light. It works best when devices are close and facing each other.



Key limitation

Infrared waves cannot penetrate walls.



TV
Remote controls

Air conditioner
Home control

02

Bluetooth

Short-range data exchange between nearby devices

HOW IT WORKS

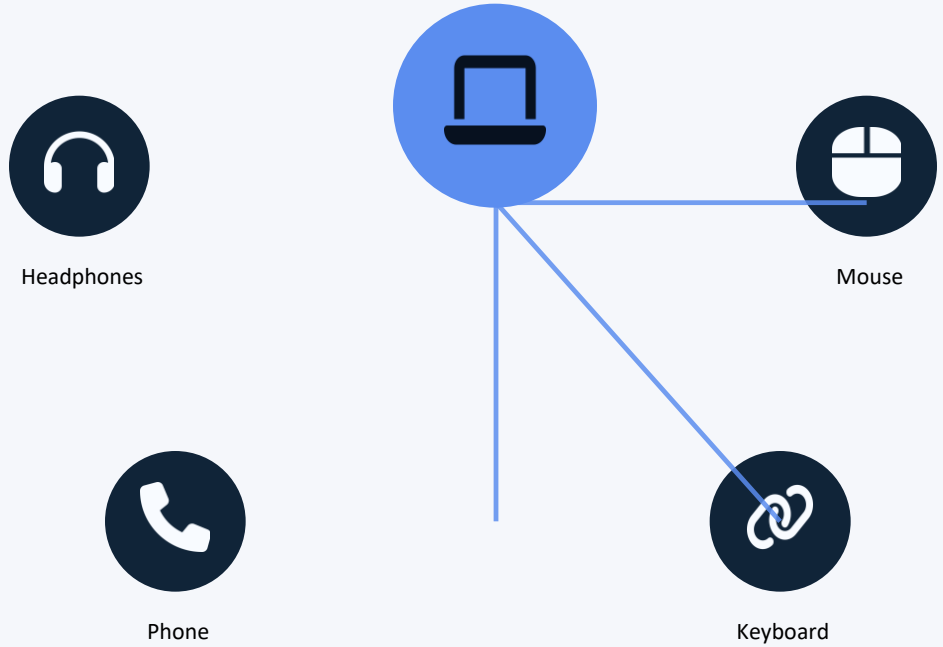
Bluetooth creates a short-range wireless link between fixed or mobile devices without needing a Wi-Fi network.

SHORT RANGE

LOW-CABLE SETUP

DATA EXCHANGE

Typical connections



Examples: wireless keyboards, mice, headphones, and phone-to-computer data transfer.

03

Wi-Fi

High-speed local networking using radio waves

HOW IT WORKS

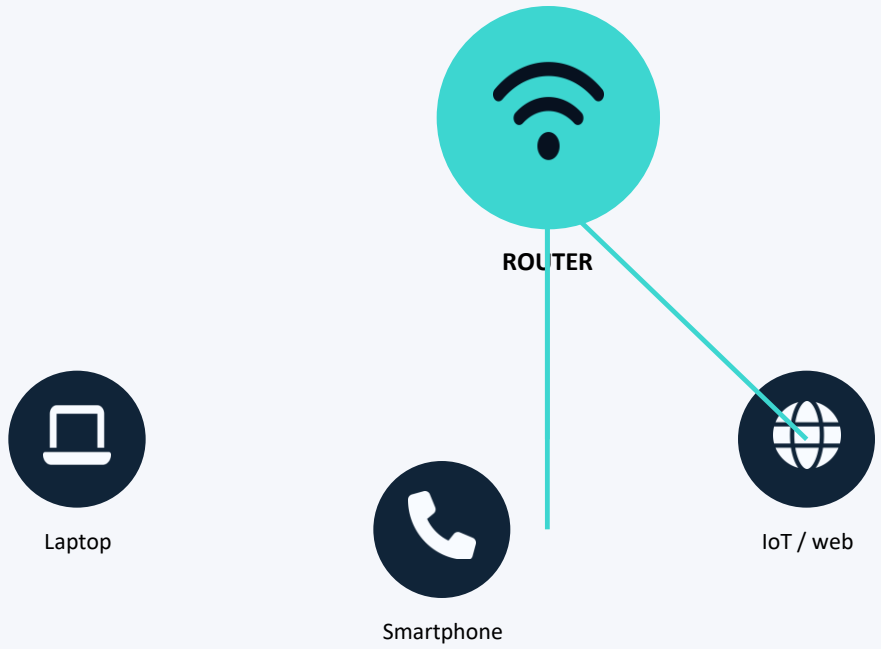
Wi-Fi uses radio waves to connect devices to a local network and usually to the internet through a wireless router.

Home / office

Internet networks

Public hotspot

Cafés, airports, campuses



Main idea: many nearby devices can share one wireless network.

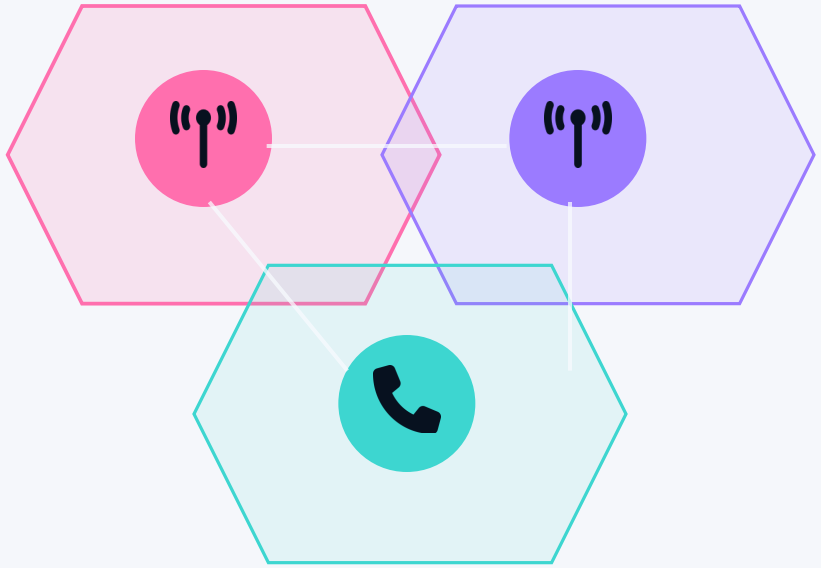
04

Cellular Networks (4G / 5G)

Wide-area mobile voice and data communication

HOW IT WORKS

Cellular networks divide coverage into “cells.” Mobile devices connect to nearby base stations as users move from place to place.



Voice calls
Mobile communication

SMS
Text messaging

Mobile internet
Apps and browsing

Streaming
Video calls and media

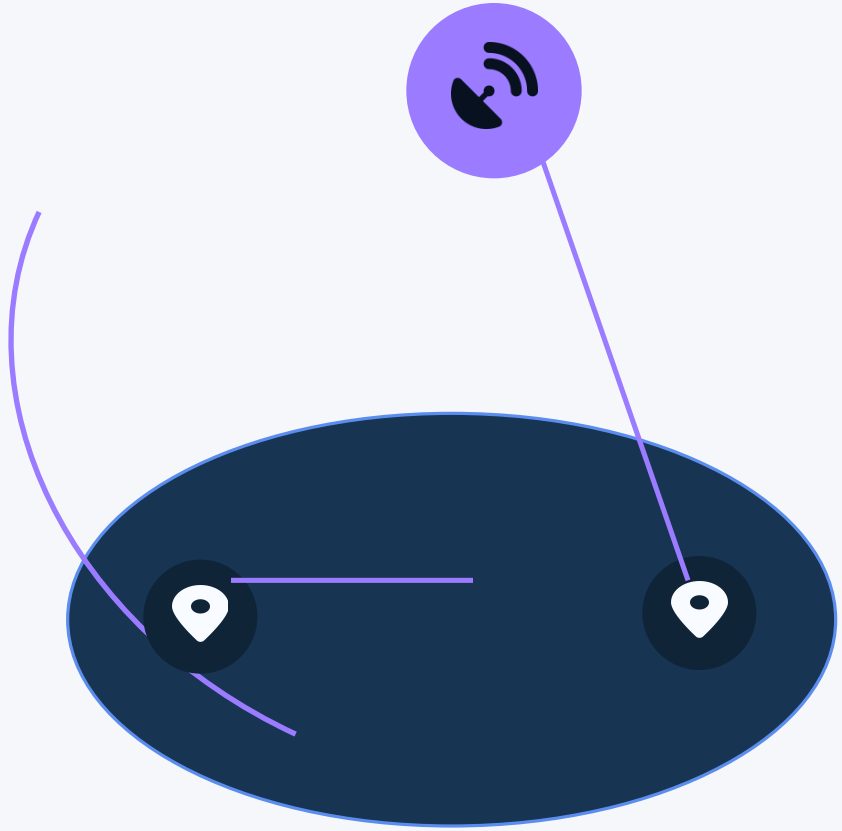
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Satellite Communication

Signals sent over very large distances through satellites

HOW IT WORKS

A ground station sends a signal up to a satellite. The satellite relays it back down to another location, enabling long-distance communication.



Satellite TV

Broadcast services

GPS

Positioning / navigation

Satellite phone

Remote communication

Remote internet

Areas without wired access

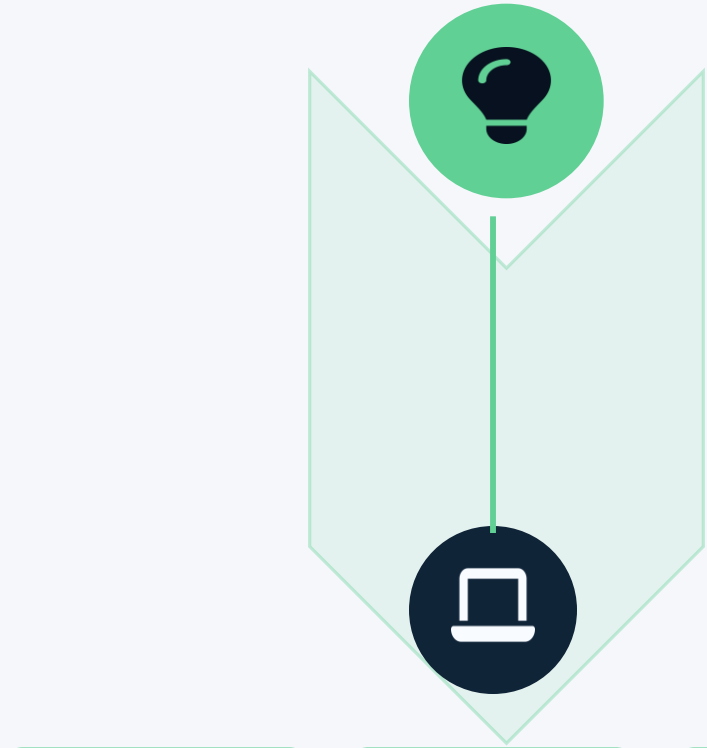
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Li-Fi (Light Fidelity)

Wireless data transmission using visible light

HOW IT WORKS

Li-Fi transmits data through rapid changes in visible light. A receiver detects those changes and converts them back into data.



VISIBLE LIGHT | HIGH SPEED | LINE OF SIGHT

Why it is interesting

It can be faster than Wi-Fi, but communication depends on light reaching the receiver directly.

REMEMBER THE DIFFERENCE

Which wireless technology fits which situation?

Think about the signal, range, and typical use.

Technology	Signal used	Range	Typical use
Infrared	Infrared light	Very short	Remote controls
Bluetooth	Radio waves	Short	Accessories / device links
Wi-Fi	Radio waves	Local	Internet & local networks
4G / 5G	Radio waves	Wide area	Mobile voice & internet
Satellite	Radio waves	Very long / global	Remote & global links
Li-Fi	Visible light	Room / line-of-sight	High-speed light-based data

Quick memory trick: IR = remote • Bluetooth = accessories • Wi-Fi = local internet • 4G/5G = mobile • Satellite = global • Li-Fi = light