CSF Third Year

Electromagnetic Waves

Active Learning Presentation on Wireless Mobile & Device Security

Presented By:
Krishnaraj Thadesar PA10,
Vedang Khare PA06,
Saubhagya Singh PA24,
Sourab Karad PA25

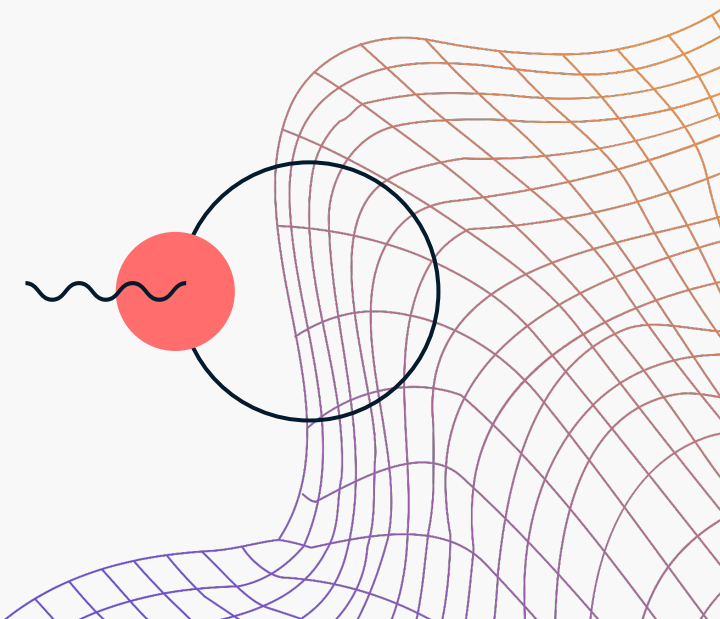
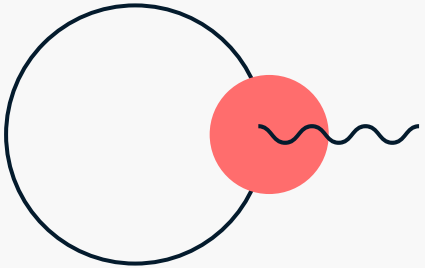


Table of contents

01.



Introduction to EM Waves

PA06. Vedang Khare

Our team

Vedang Khare

Introduction
And Explanation

Saubhagya Singh

Demo and
Hacking

Sourab Karad

Technological
Advancements

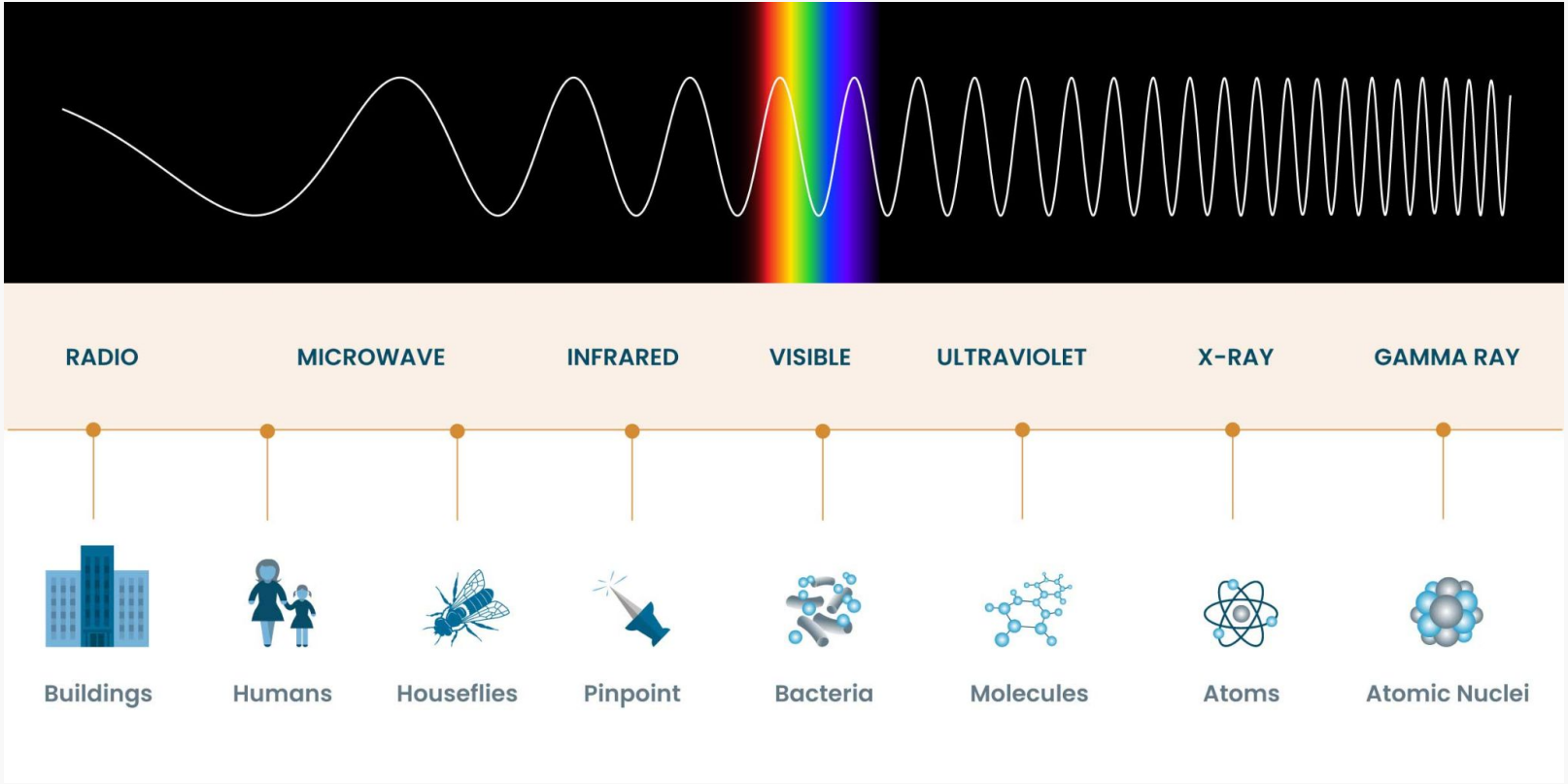
Krishnaraj Thadesar

Applications of
EM Waves

Introduction To Electromagnetic Waves

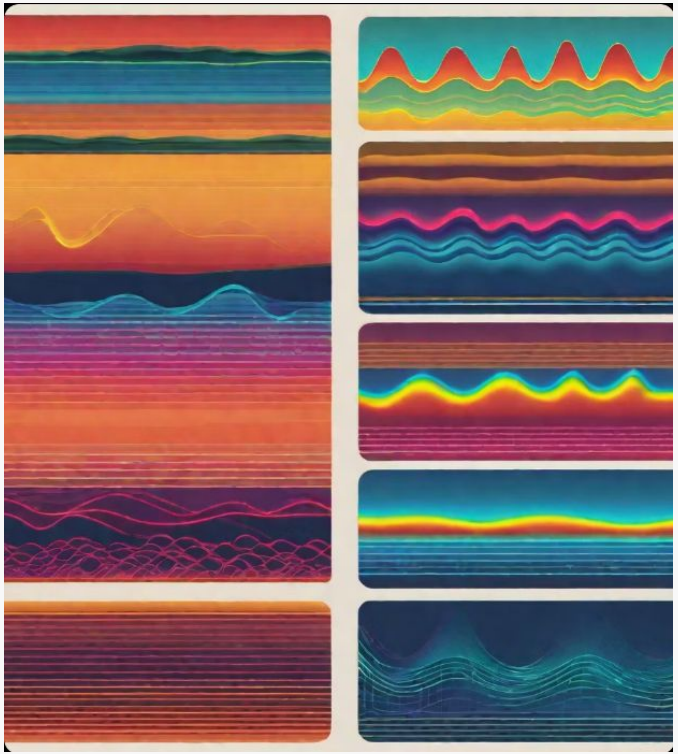
Electromagnetic waves are a *fundamental concept* in science and technology. They are a type of wave that is created by the movement of *electric and magnetic fields*. These waves can travel through space and are responsible for many of the technologies that we use every day, *including radio, television, and cell phones.*

Electromagnetic waves have a wide range of applications in fields such as *medicine*, *telecommunications*, and *astronomy*. Understanding the properties of these waves is essential to understanding how they work and how they can be used to improve our lives.


RADIO
MICROWAVE
INFRARED
VISIBLE
ULTRAVIOLET
X-RAY
GAMMA RAY
Buildings
Humans
Houseflies
Pinpoint
Bacteria
Molecules
Atoms
Atomic Nuclei

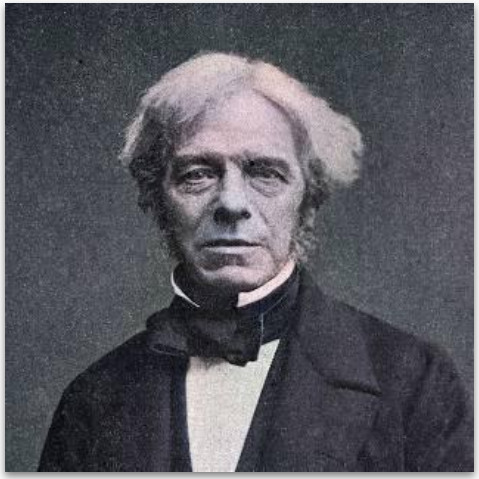
A Brief History

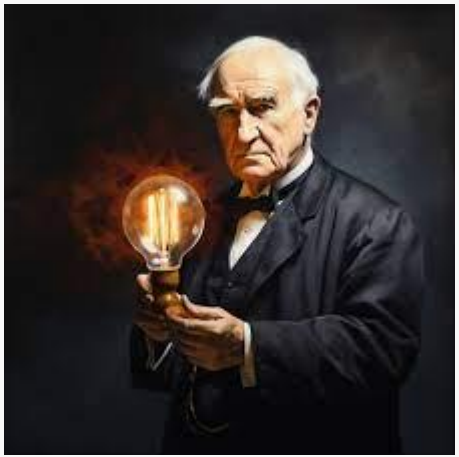
The study of electromagnetic waves dates back to the 19th century, when James Clerk Maxwell formulated the theory of electromagnetism. This theory predicted the existence of electromagnetic waves, which were later discovered by Heinrich Hertz in 1887.



The Father of Electricity

Other notable scientists who contributed to the understanding of electromagnetic waves include *Michael Faraday*, who discovered electromagnetic induction, and *Thomas Edison*, who developed the first practical light bulb using a carbon filament.





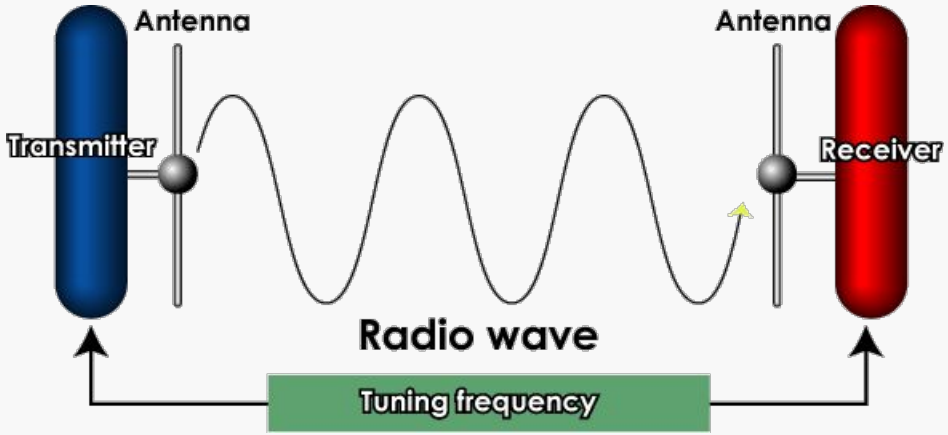
02.

Different Sections of the Spectrum

A Brief Description about all the different sections of the EM Spectrum

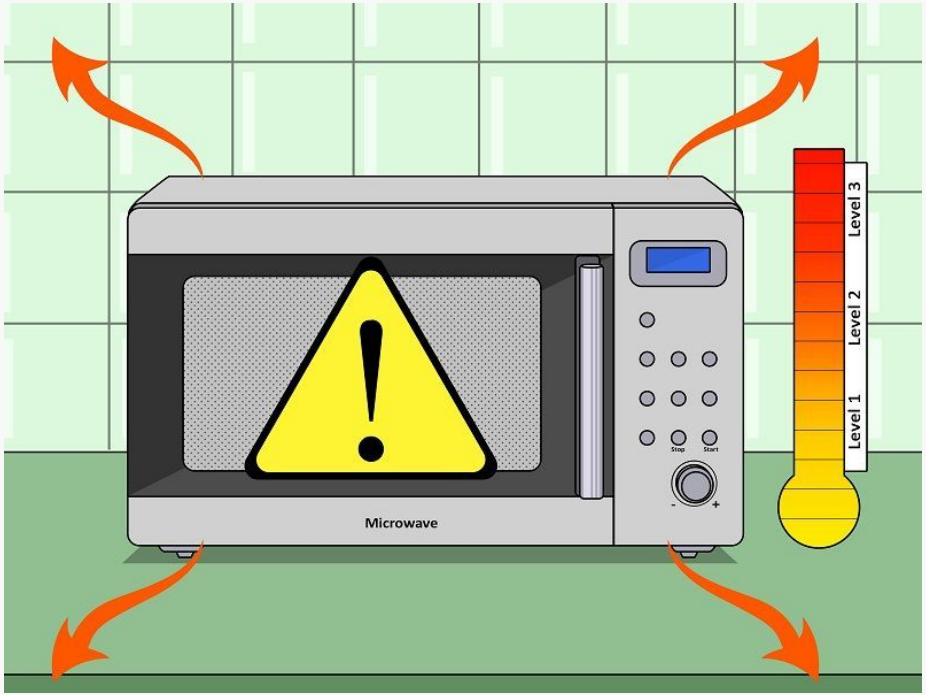
Radio Waves

Radio waves have the longest wavelengths and the lowest frequencies in the electromagnetic spectrum. They are used for communication, such as radio and television broadcasting, cell phone signals, and GPS navigation.

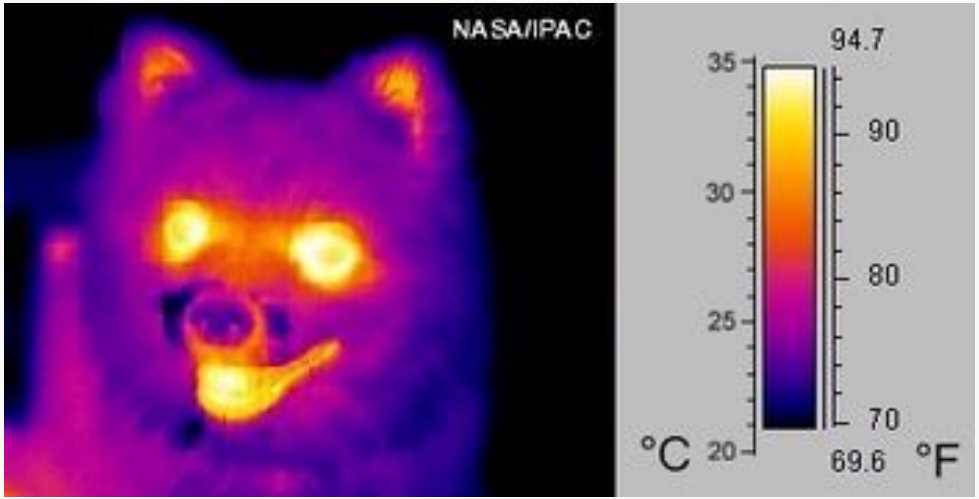


Microwaves

Microwaves have shorter wavelengths and higher frequencies than radio waves. They are used for communication, such as satellite and microwave transmission, as well as cooking food in microwave ovens.



Infrared



Infrared radiation has longer wavelengths and lower frequencies than visible light. It is used for heating, such as in infrared heaters, as well as for remote sensing, such as in thermal imaging cameras.

Visible Light

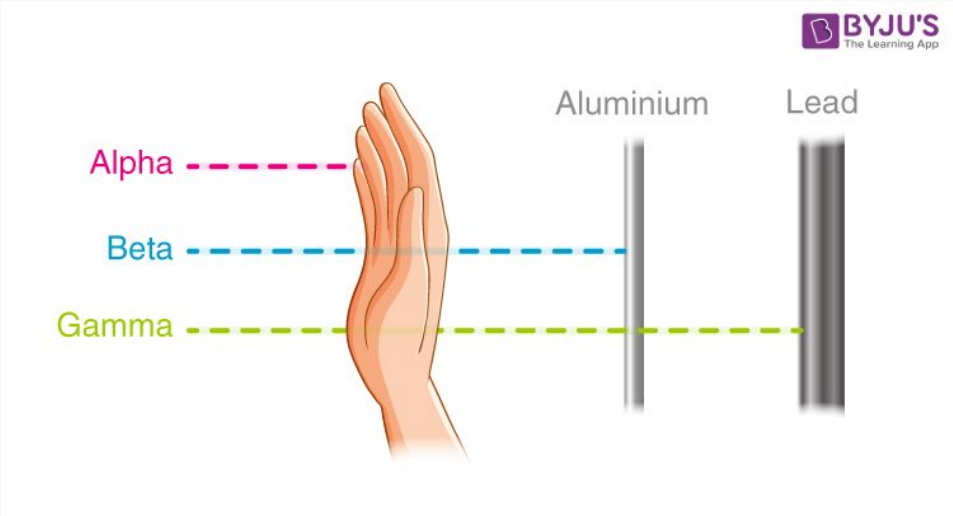
Visible light is the only section of the electromagnetic spectrum that can be seen by the human eye. It has a range of wavelengths and frequencies, with each color corresponding to a different wavelength. Visible light is used for illumination and for visual communication.

This is an image taken under Visible Light

Ultraviolet

Ultraviolet radiation has shorter wavelengths and higher frequencies than visible light. It is used for sterilization, such as in hospitals and water treatment plants, as well as for tanning and black lights.

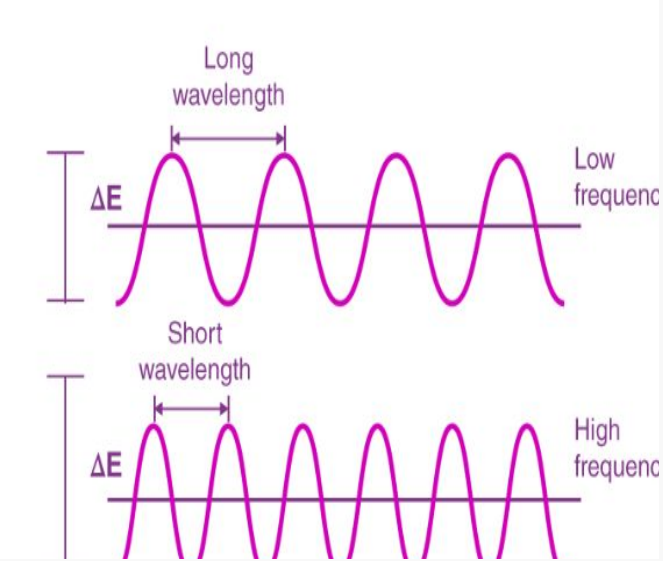
X-rays and Gamma Rays



X-rays and gamma rays have the shortest wavelengths and the highest frequencies in the electromagnetic spectrum. They are used for medical imaging, such as X-ray and CT scans, as well as for radiation therapy and in nuclear medicine.

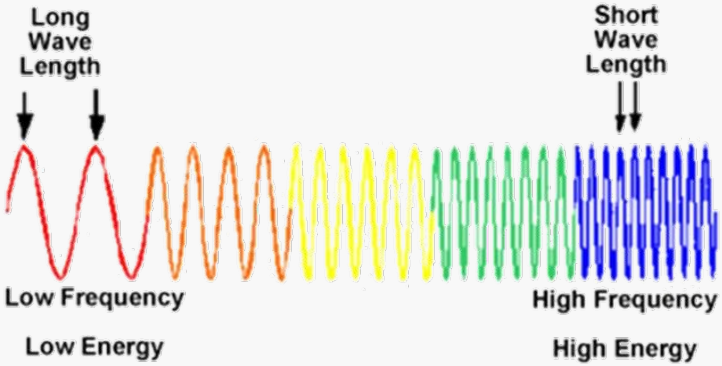
Wavelengths And Frequencies

Electromagnetic waves are characterized by their wavelengths and frequencies. Wavelength is the distance between two consecutive peaks or troughs of a wave, while frequency is the number of waves that pass a point in a given amount of time. The relationship between wavelength and frequency is inverse; as wavelength increases, frequency decreases, and vice versa.



Short Wavelength = High Energy

Shorter wavelengths have higher frequencies and more energy. For example, gamma rays have the shortest wavelengths and highest frequencies, while radio waves have the longest wavelengths and lowest frequencies.The electromagnetic spectrum is divided into different sections based on wavelength and frequency. These sections include radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays.



03.

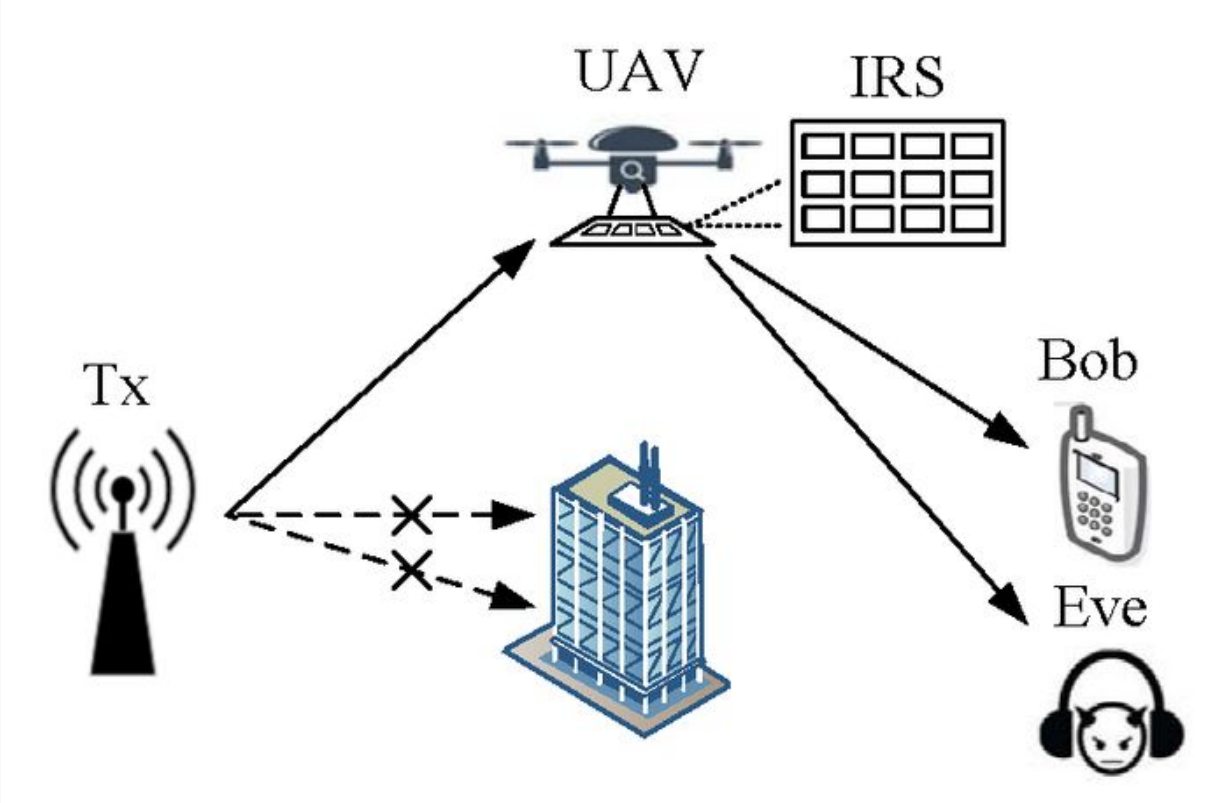
Application of EM waves

PA10. Krishnaraj Thadesar

1. Wireless Communication Security

- The use of electromagnetic waves, particularly radio waves, to implement encryption measures and protect wireless communication channels from unauthorized access or interception.

- Secure Data Transmission: EM waves, especially radio waves, are applied to secure wireless communication channels through encryption protocols, ensuring the confidentiality of transmitted data.
- Prevention of Unauthorized Access: Utilizing EM waves helps prevent unauthorized access and eavesdropping, enhancing the overall security of wireless networks.

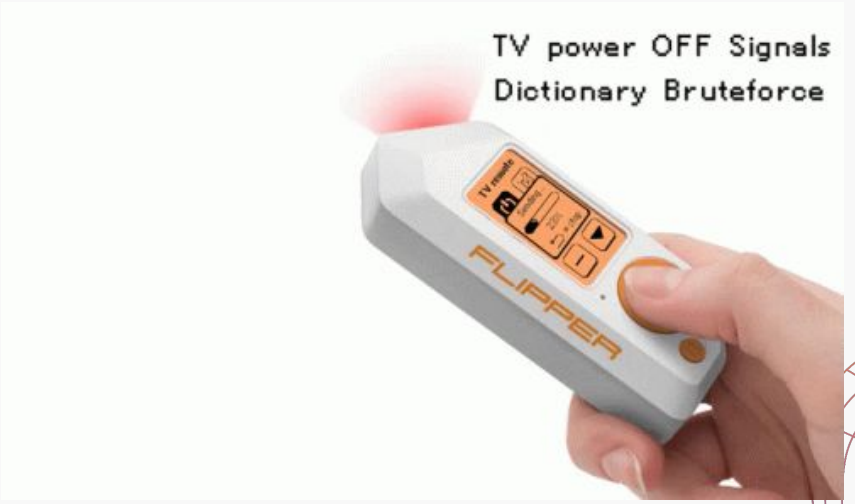

UAV
IRS
Tx
Bob
Eve

2. RFID Technology

- The application of electromagnetic waves, particularly radio frequencies, for the purpose of identifying and tracking objects in a variety of industries, leading to improved operational efficiency.

- Object Identification: EM waves, in the form of radio frequency signals, are used in RFID technology to identify and track objects efficiently, providing benefits in supply chain visibility and inventory control.
- Enhanced Management: RFID enables the efficient tracking and management of tagged items, enhancing processes such as inventory management and logistics.


ANIMAL


TV power OFF Signals
Dictionary Bruteforce
FLIPPER


TrackSeal
www.trackseal.com

3. Mobile Phone Networks

- The utilization of electromagnetic waves, particularly microwaves, in the infrastructure of mobile networks to enable efficient data transmission and reliable communication between cell towers and mobile devices.

- Data Transmission: Microwaves in mobile phone networks facilitate the high-speed transmission of data between cell towers and mobile devices, supporting the growing demand for mobile data services.
- Reliable Communication: EM waves play a crucial role in ensuring reliable and fast communication in mobile phone networks, contributing to the seamless operation of mobile services.


5G

4. Wireless Keyboards and Mice

- The use of electromagnetic waves to establish wireless communication between computers and input devices, such as keyboards and mice, offering users a more flexible and uncluttered computing experience.

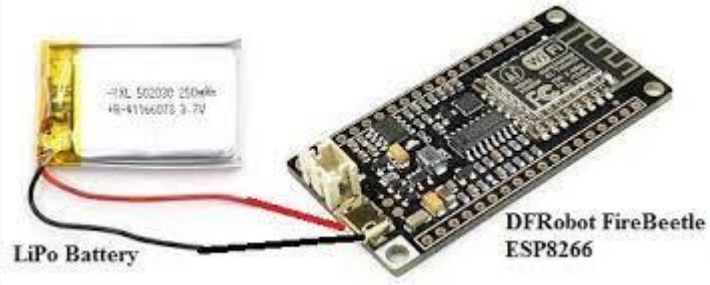
- Cable-Free Peripherals: EM waves enable wireless communication in keyboards and mice, providing users with cable-free peripherals for increased flexibility and convenience.
- Addressing Workspace Needs: The application of EM waves in wireless peripherals addresses the need for cable-free solutions, improving workspace organization and reducing clutter.


logitech
esc
backspace
tab
caps lock
enter
shift
shift
ctrl
fn
start
alt
alt
ctrl

5. Jamming and Spoofing Detection

- The utilization of electromagnetic wave analysis to identify and counteract security threats, such as jamming and spoofing, in wireless communication, enhancing the overall security of networks.
- Security Threat Mitigation: EM wave analysis is applied to detect and mitigate security threats such as jamming and spoofing attempts in wireless communication, safeguarding the integrity of communication channels.
- Counteracting Unauthorized Activities: The detection of attempts to disrupt or manipulate EM waves helps counteract unauthorized activities, preventing potential threats to wireless networks.


DEATH TO
Wi-Fi
$5
Wi-Fi
JAMMER


LiPo Battery
DFRobot FireBeetle
ESP8266


solutel
TECHNOLOGIES

6. Faraday Cages for Mobile Security

- The application of EM wave principles in constructing Faraday cages to isolate mobile devices from external electromagnetic signals, ensuring a secure environment for sensitive operations.

- Isolation from External Signals Faraday cages, utilizing EM wave principles, isolate mobile devices from external electromagnetic signals, providing a secure environment for sensitive operations.
- Security in Controlled Spaces The application of Faraday cages enhances security in controlled spaces by blocking external EM signals and preventing potential security breaches.

7. Electromagnetic Pulse (EMP) Shielding

- The use of electromagnetic wave shielding to protect electronic devices and critical infrastructure from damage caused by electromagnetic pulses (EMPs), ensuring the continued reliability of electronic systems.
- Protection from EMP Attacks: EM wave shielding is applied to protect electronic devices from damage caused by electromagnetic pulses, safeguarding critical infrastructure from potential EMP attacks.
- Ensuring Electronic System Reliability: The application of EM wave shielding ensures the reliability of electronic systems in challenging environments, preventing disruptions caused by EMP events.


EMP
SHIELD
MISSION
AMERICA
DC-12V-MICRO
EMPShield.com
PATENTED

Other Vital Uses

- Medical Imaging
- Broadcasting and Television
- Satellite Communication
- Radar Systems
- Global Positioning System (GPS)
- Wireless Power Transmission
- Industrial Heating and Processing
- Non-Destructive Testing
- Environmental Monitoring
- Wireless Sensor Networks

04.

Exploitation for Hacking

PA24. Saubhagya Singh

WiFi Hacking in Relation to EM Waves

Electromagnetic waves, including radio waves, are used for transmitting information wirelessly, and Wi-Fi operates within the radio frequency (RF) spectrum. Wi-Fi, short for Wireless Fidelity, is a technology that allows devices to exchange data wirelessly using radio waves within the electromagnetic spectrum.

The relation between electromagnetic waves and Wifi hacking lies in the fact that Wi-Fi signals are a form of electromagnetic radiation, specifically radio waves. When we refer to Wifi hacking, it typically involves unauthorized access to a Wi-Fi network for various purposes, such as eavesdropping on communication, stealing sensitive information, or using the network's resources without permission.

Types of Attacks

- Brute Force Attacks
- Dictionary Attacks
- WPS PIN Attacks
- Packet Sniffing
- Evil Twin Attacks
- Rogue Access Points
- Phishing
- Man-in-the-Middle Attacks

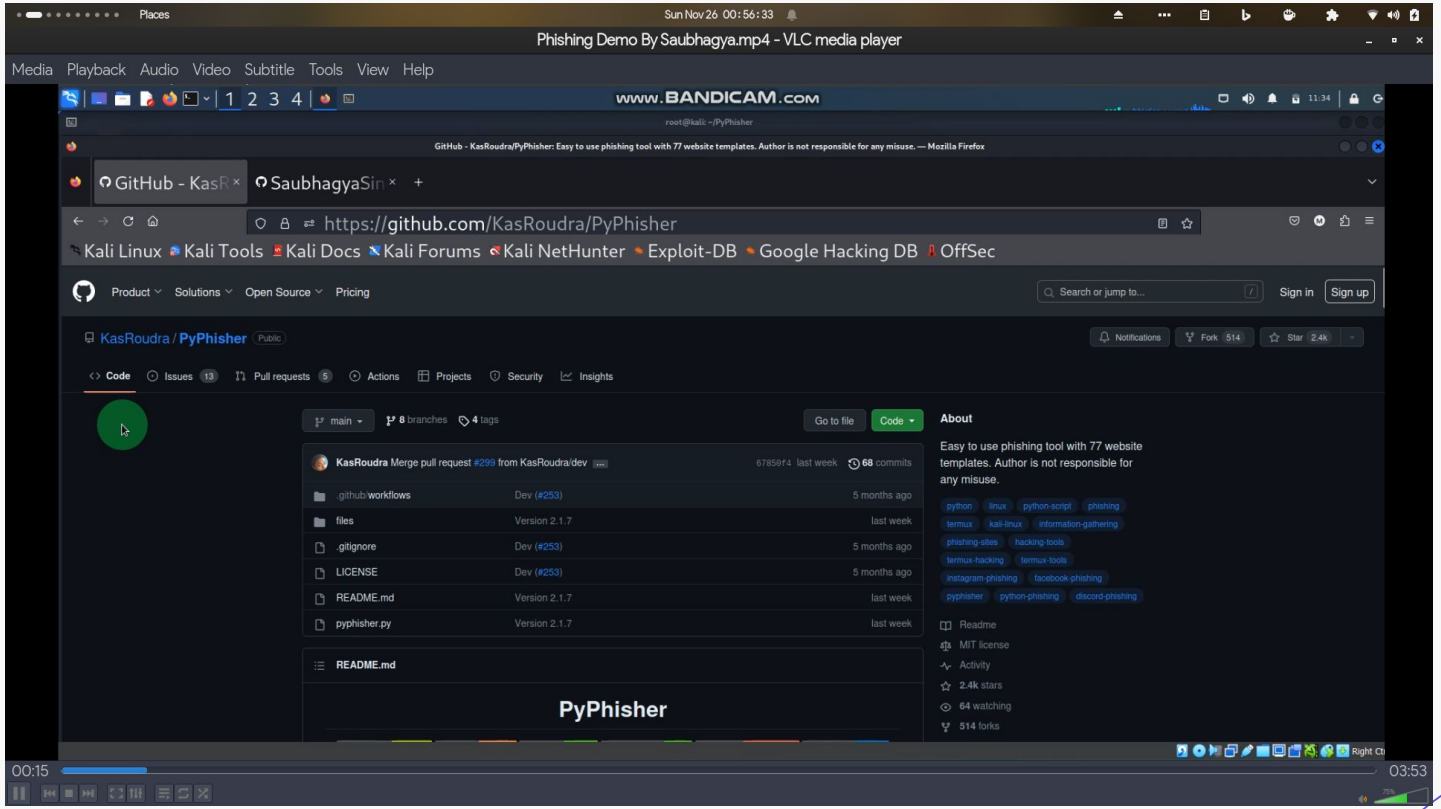
BlueTooth Hacking

- Bluejacking:Sending unsolicited messages to Bluetooth devices.
- Bluesnarfing:Unauthorized access to information on a Bluetooth device.
- Bluebugging:Taking control of a Bluetooth device, including making calls and sending texts.
- Denial of Service (DoS) Attacks:Disrupting normal Bluetooth device functioning through overwhelming connection requests.

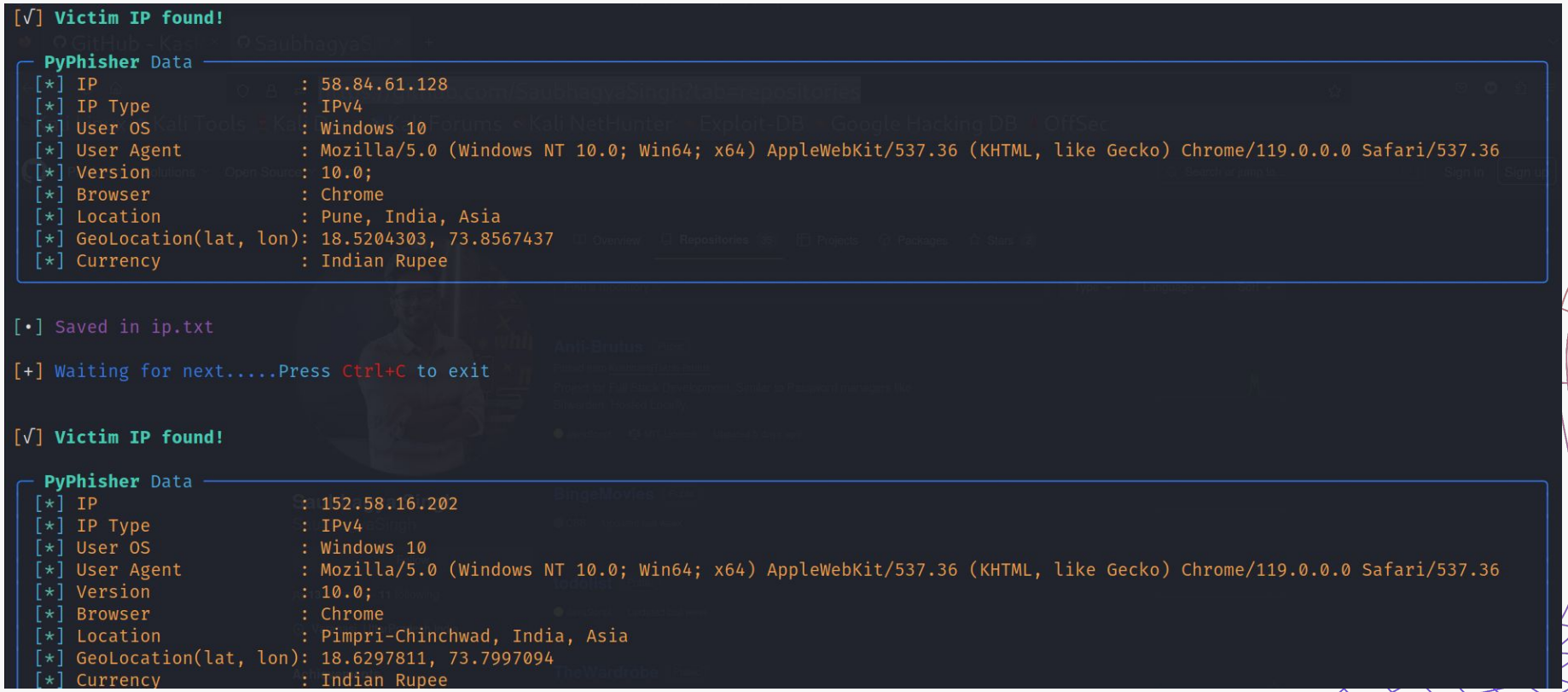
Bluetooth Hacking Attacks

- Bluetooth Honeypot Attacks:Mimicking a legitimate Bluetooth device to attract and monitor attackers.
- Bluetooth Sniffing:Eavesdropping on Bluetooth communications to capture sensitive information.
- Impersonation (Spoofing) Attacks:Attempting to impersonate a trusted device to gain unauthorized access.

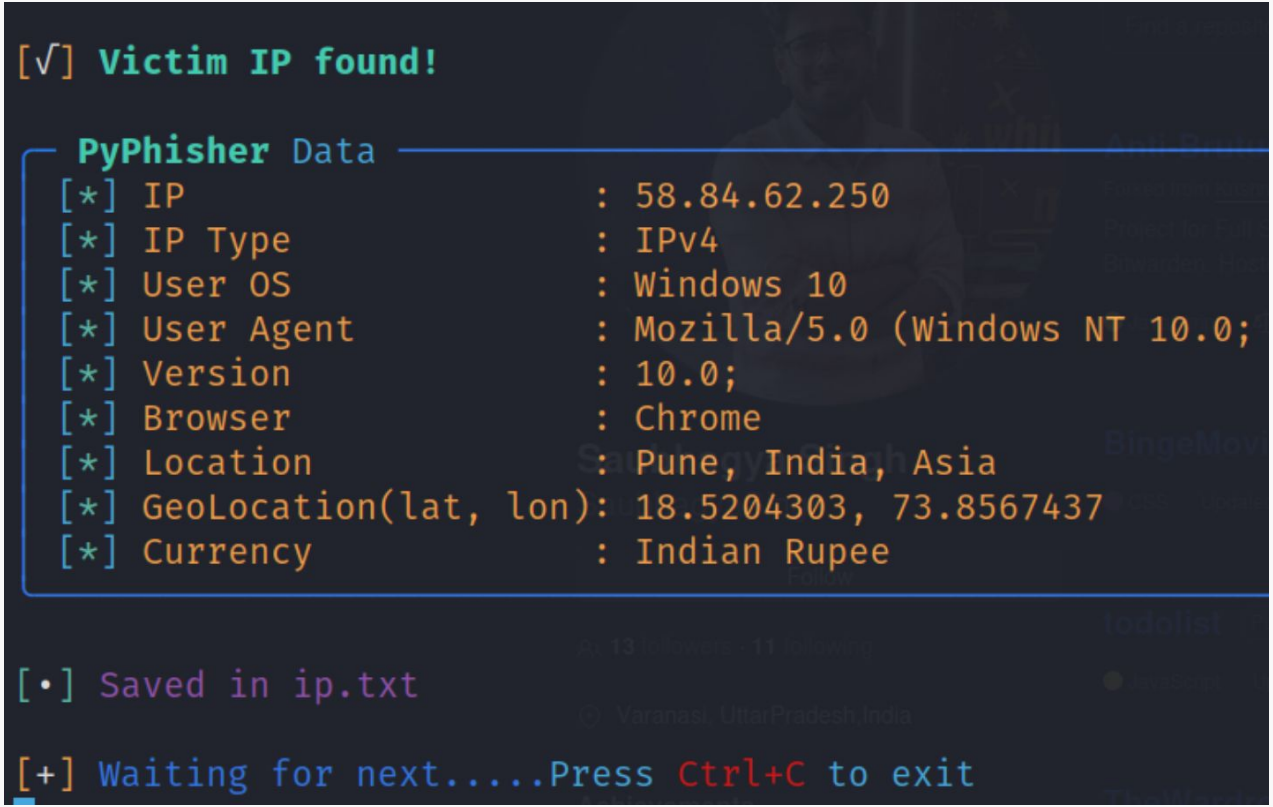
Demo Video: Fern Wifi Hacking Tool



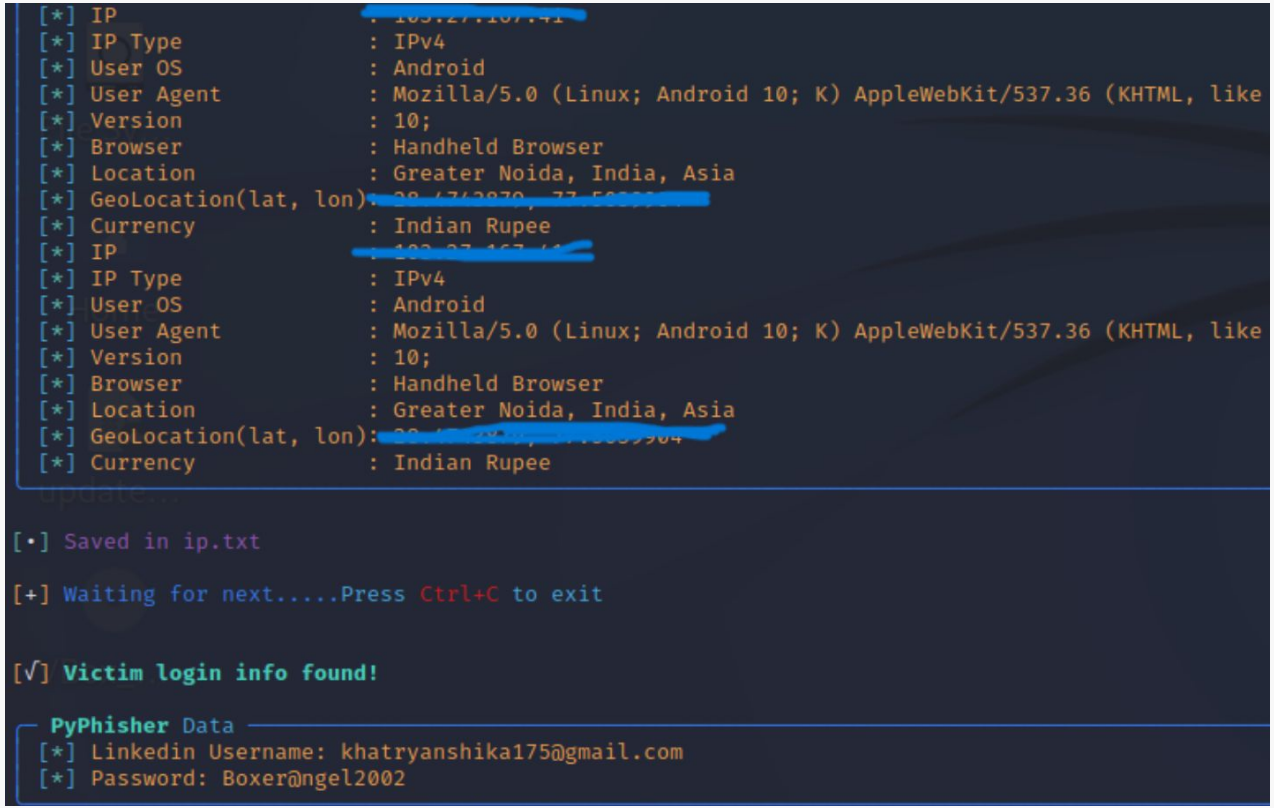
Screenshots of a Phishing Attack

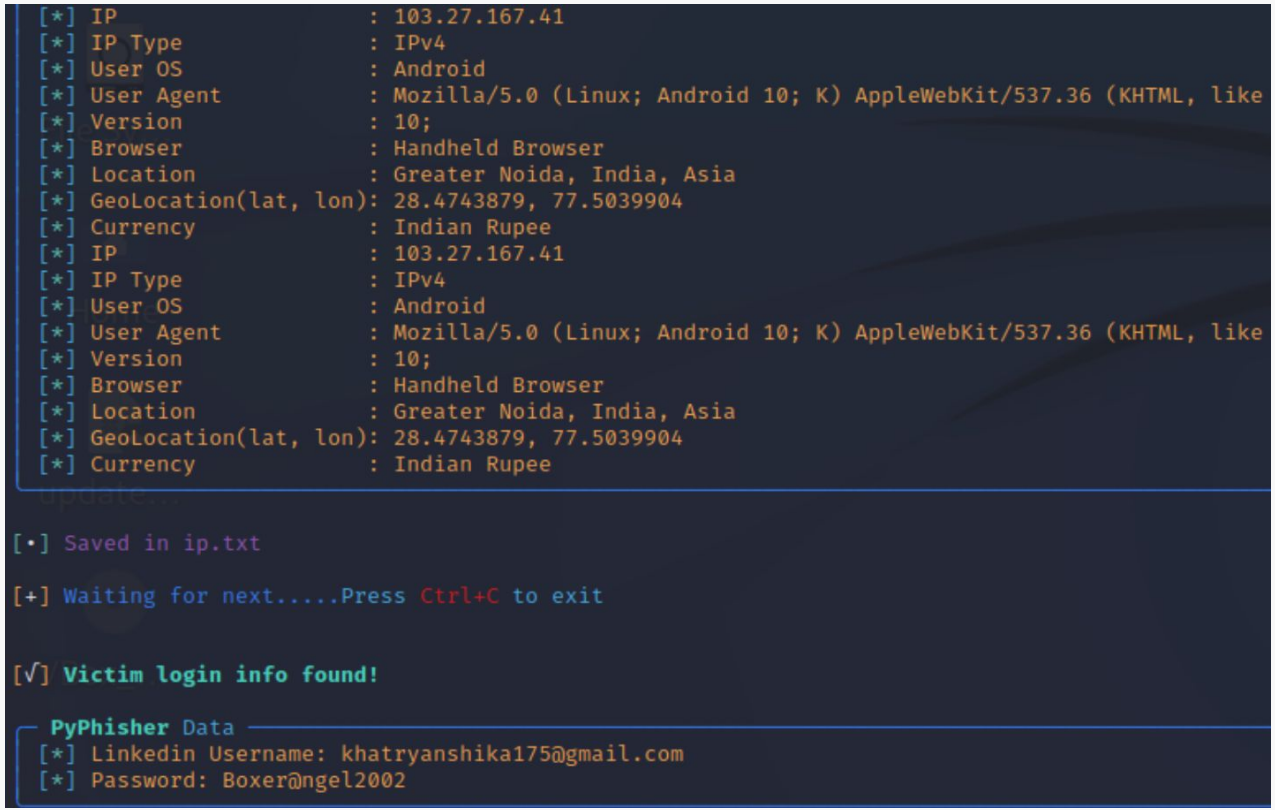


Aaron Philip

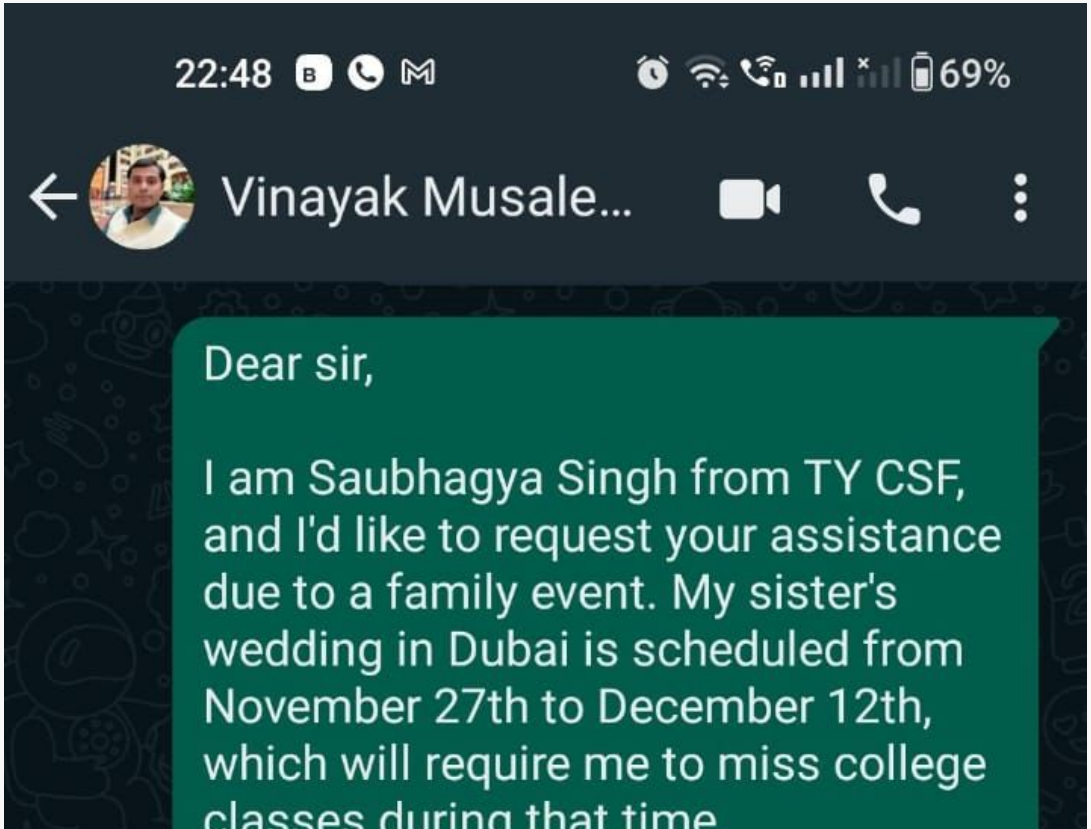


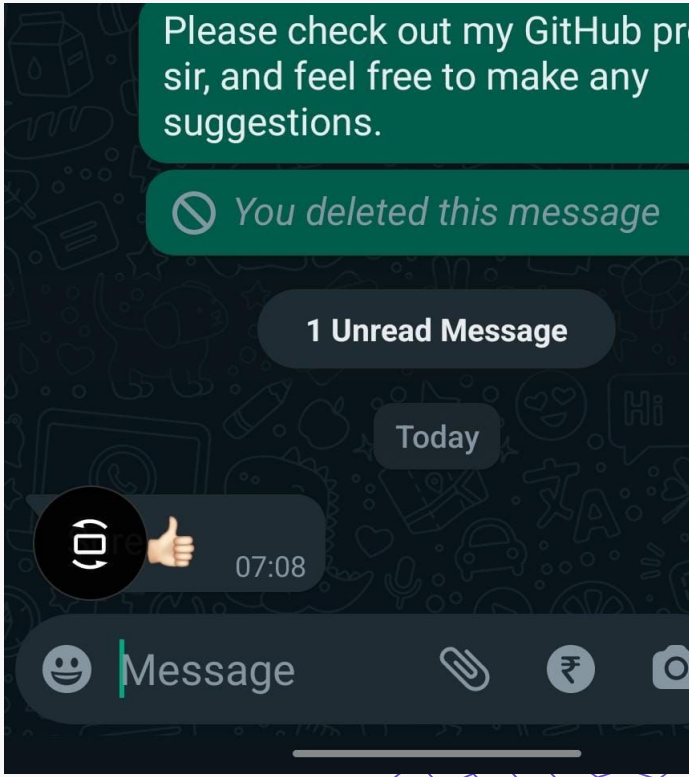
Abhijeet Singh


[*] IP : [redacted]
[*] IP Type : IPv4
[*] User OS : Android
[*] User Agent : Mozilla/5.0 (Linux; Android 10; K) AppleWebKit/537.36 (KHTML, like
[*] Version : 10;
[*] Browser : Handheld Browser
[*] Location : Greater Noida, India, Asia
[*] GeoLocation(lat, lon): [redacted]
[*] Currency : Indian Rupee
[*] IP : [redacted]
[*] IP Type : IPv4
[*] User OS : Android
[*] User Agent : Mozilla/5.0 (Linux; Android 10; K) AppleWebKit/537.36 (KHTML, like
[*] Version : 10;
[*] Browser : Handheld Browser
[*] Location : Greater Noida, India, Asia
[*] GeoLocation(lat, lon): [redacted]
[*] Currency : Indian Rupee
[•] Saved in ip.txt
[+] Waiting for next.....Press Ctrl+C to exit
[√] Victim login info found!
PyPhisher Data
[*] Linkedin Username: khatryanshika175@gmail.com
[*] Password: Boxer@ngel2002


[*] IP : 103.27.167.41
[*] IP Type : IPv4
[*] User OS : Android
[*] User Agent : Mozilla/5.0 (Linux; Android 10; K) AppleWebKit/537.36 (KHTML, like
[*] Version : 10;
[*] Browser : Handheld Browser
[*] Location : Greater Noida, India, Asia
[*] GeoLocation(lat, lon): 28.4743879, 77.5039904
[*] Currency : Indian Rupee
[*] IP : 103.27.167.41
[*] IP Type : IPv4
[*] User OS : Android
[*] User Agent : Mozilla/5.0 (Linux; Android 10; K) AppleWebKit/537.36 (KHTML, like
[*] Version : 10;
[*] Browser : Handheld Browser
[*] Location : Greater Noida, India, Asia
[*] GeoLocation(lat, lon): 28.4743879, 77.5039904
[*] Currency : Indian Rupee
[•] Saved in ip.txt
[+] Waiting for next.....Press Ctrl+C to exit
[√] Victim login info found!
PyPhisher Data
[*] Linkedin Username: khatryanshika175@gmail.com
[*] Password: Boxer@ngel2002

Vinayak Sir Attempt - Phishing Attack





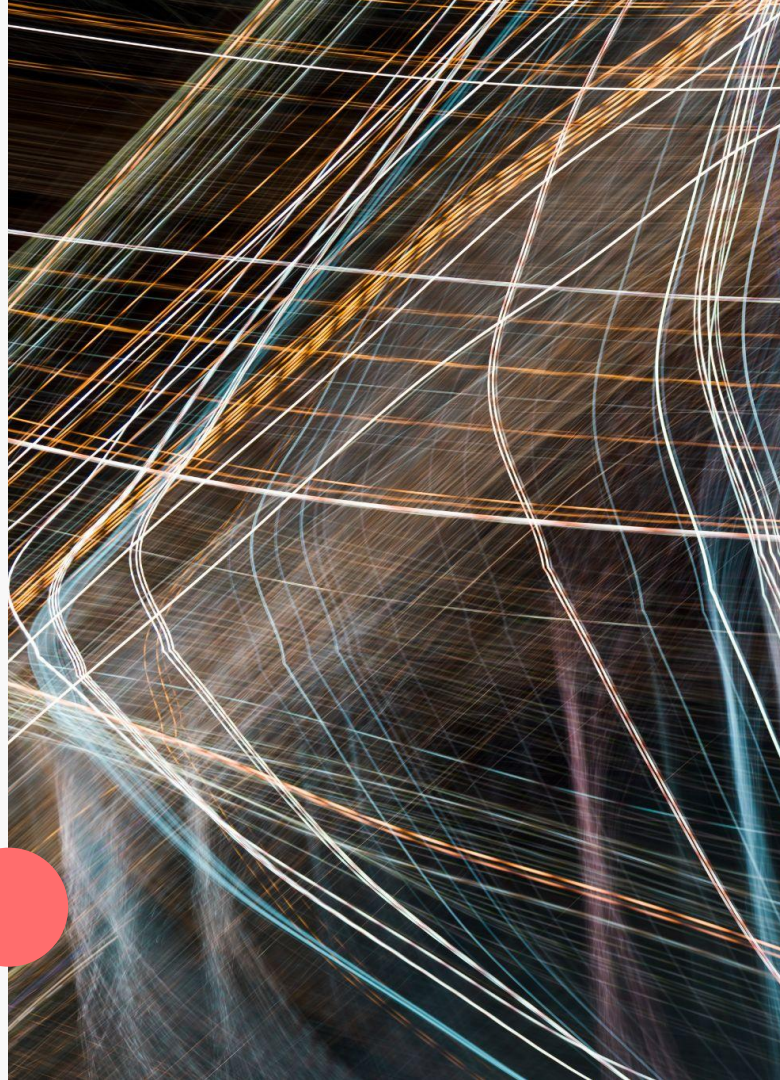
05.

Developments in Wifi Tech

PA24. Sourab Karad

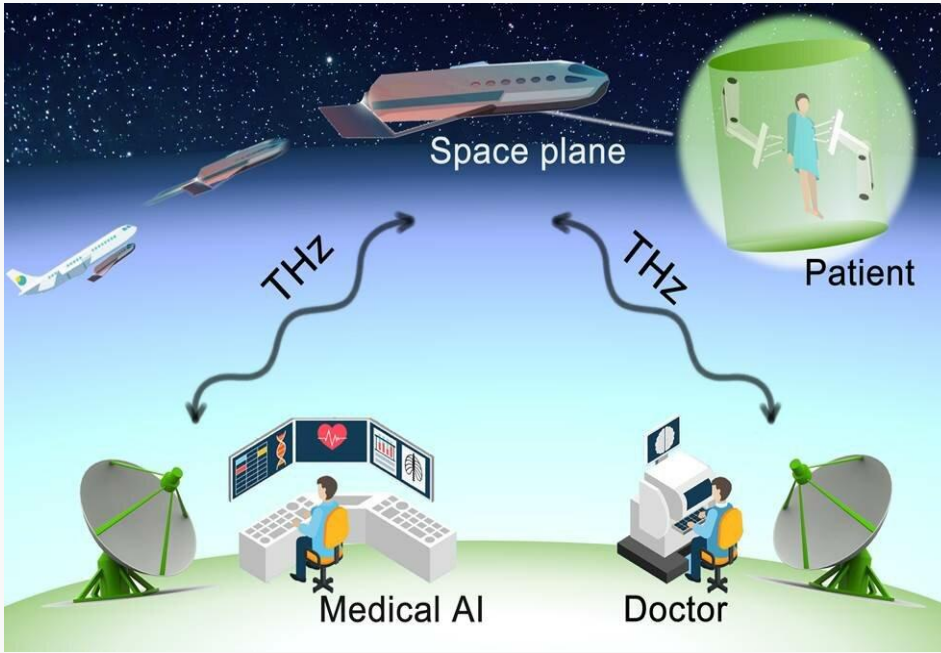
WiFi 7

Just as WiFi standards have evolved from 802.11a to 802.11ax (WiFi 6), the next standard, possibly called WiFi 7, is anticipated. It would likely bring even higher data rates, improved efficiency, and reduced latency.



Terahertz (THz) Communication

Research is ongoing in utilizing terahertz frequencies for wireless communication. Terahertz waves have the potential to offer extremely high data rates, but technical challenges need to be addressed for practical implementation.



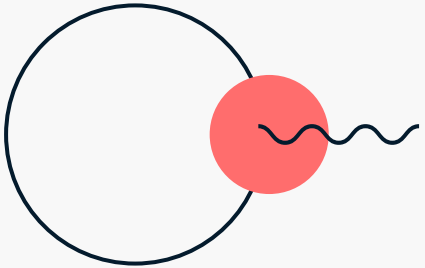
More future projects on WIFI tech advancements

- AI Integration
- Mesh Networking
- Energy Efficiency

Frequency and electromagnetic wave

For 1g, 2g and 5g

06.



Frequency and electromagnetic waves

For 1g, 2g and 5g

1G (First Generation)

- Frequency Range: Primarily in the 800 MHz and 900 MHz bands.
- Modulation: Analog signals for voice communication.
- Technology: First-generation mobile networks were based on analog technology, allowing for basic voice communication.

2G (Second Generation)

- Frequency Range: Ranged from 900 MHz to 1.9 GHz.
- Modulation: Digital signals using various modulation techniques.
- Technology: 2G introduced digital technologies, enabling not only voice communication but also text messaging (SMS).

5G (Fifth Generation)

Frequency Range:

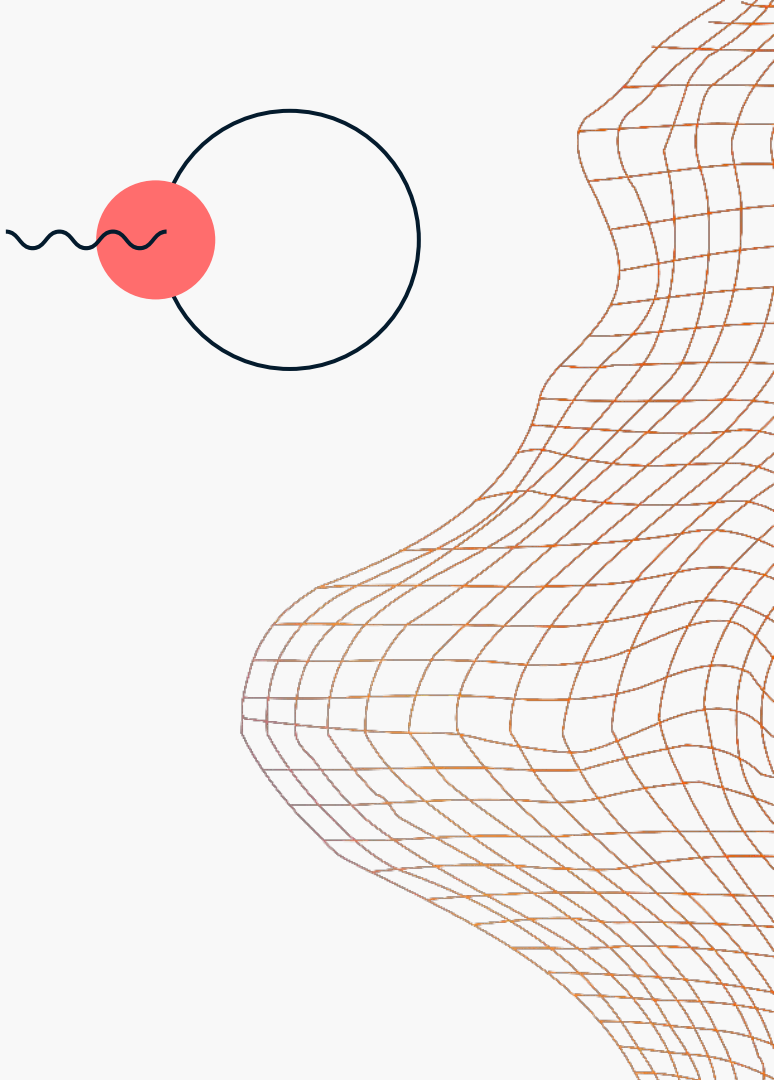
Utilizes a wide range of frequencies, including low-band (sub-1 GHz), mid-band (1-6 GHz), and high-band (millimeter-wave) frequencies.

Modulation

Utilizes advanced modulation techniques, including higher-order modulation, massive MIMO, and beamforming.

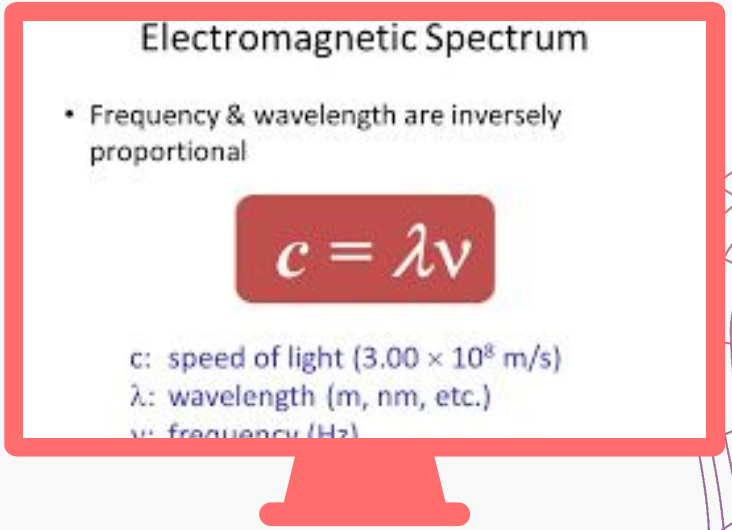
Technology

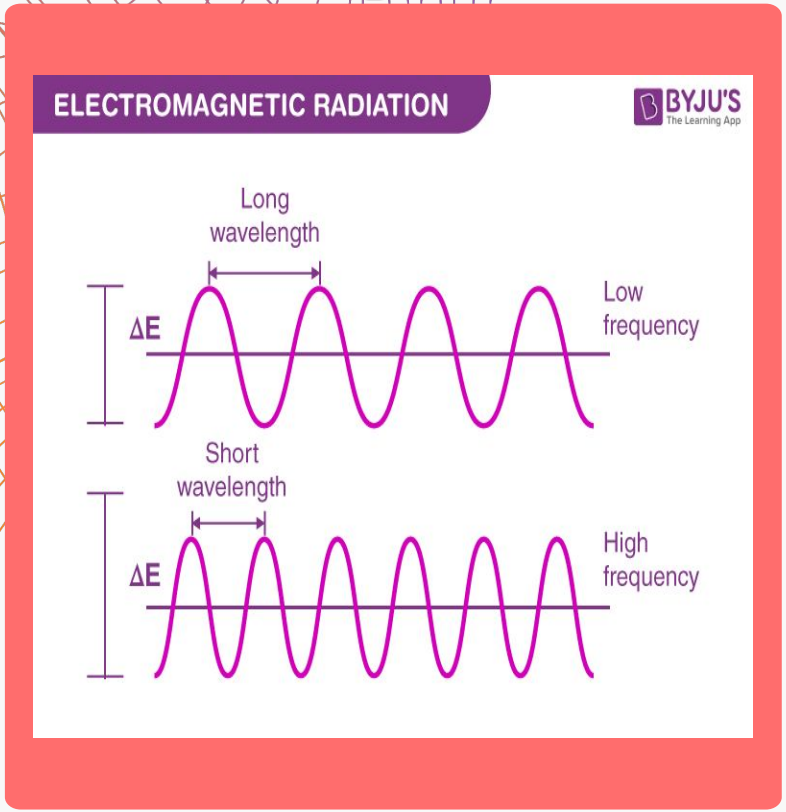
5G represents a significant advancement, offering higher data rates, lower latency, and increased device density. It utilizes a mix of frequency bands to balance coverage and capacity.



How Frequency Affects Speed

Frequency plays a crucial role in determining the speed and data-carrying capacity of a communication system, including wireless technologies like WiFi and mobile networks. Here are the key ways in which frequency affects speed:





Wavelength and Frequency Relationship

Frequency and wavelength are inversely proportional. Higher frequency corresponds to shorter wavelengths, and lower frequency corresponds to longer wavelengths. This relationship is described by the equation:

$c = f\lambda$, where

c is the speed of light,

f is the frequency, and

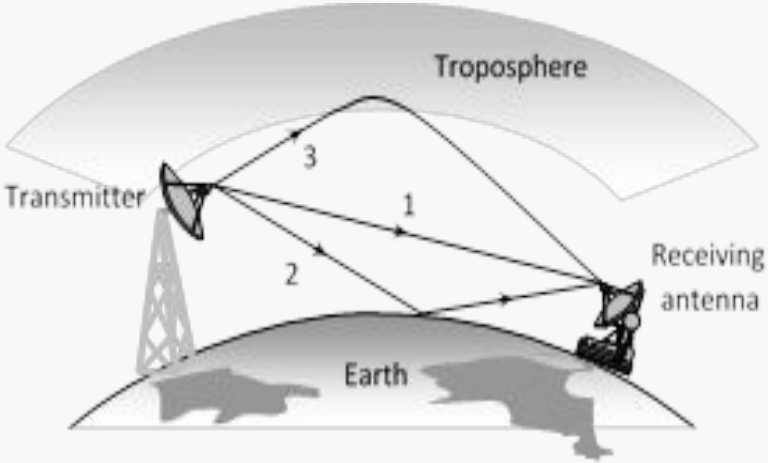
λ is the wavelength.x`

Data Transfer Rates

In the context of wireless communication, higher frequencies generally allow for higher data transfer rates. This is because more cycles of the electromagnetic wave can be transmitted per unit of time

Propagation Distance

Higher frequencies often result in shorter propagation distances. This is due to factors like increased absorption by atmospheric gases and higher susceptibility to obstacles. Lower frequencies, on the other hand, can propagate over longer distances.



Why 5g and 6g are faster?

Higher Frequencies (Millimeter Waves)

These higher frequencies provide a larger bandwidth, allowing for faster data transmission

Massive MIMO (Multiple Input, Multiple Output)

Massive MIMO involves the use of a large number of antennas at both the transmitter and receiver

Advanced Modulation Techniques

5G employs advanced modulation techniques, such as higher-order modulation (e.g., 256-QAM), allowing more data to be encoded in each transmission

Beamforming

Beamforming allows the focused transmission of signals in specific directions, optimizing signal strength and quality.

Conclusion

Summary and Conclusion

Thanks!

Do you have any questions?

CREDITS: This presentation template was created by **Slidesgo**, and includes icons by **Flaticon**, and infographics & images by **Freepik**

Resources