

CS102- Application of Information Communication Technologies

Wireless and Mobile Communications

WHY WIRELESS COMMUNICATION?

- Freedom from wires. No bunch of wires running from here and there.
- “Auto Magical” instantaneous communication without physical connection setup e.g.- Bluetooth, Wi-Fi.
- Global coverage Communication can reach where wiring is infeasible or costly.
- Stay connected, flexibility to connect multiple devices

WHAT IS WIRELESS COMMUNICATION?

- Transmitting/receiving voice and data using electromagnetic waves in open space.
- The information from sender to receiver is carried over a well-defined channel.
- Each channel has a fixed frequency bandwidth and capacity(bit rate).
- Different channels can be used to transmit information in parallel and independently.

How transmission work?

- When an antenna is attached to electrical circuit of a computer or wireless device, it converts the digital data into wireless signals and spreads all over within its frequency range. The receptor on the other end receives these signals and converts them back to digital data.

TYPES OF WIRELESS TRANSMISSION

- Infrared transmissions.
- Radio transmissions.
- Microwave transmissions.
- Communications Satellite.



INFRARED TRANSMISSIONS

- Infrared (IR) is a wireless transmission medium that sends signals using infrared light waves.
- Frequency range: 300 GHz to 400 THz.
- Widely used for short-range communication, unable to pass through solid objects, used for indoor wireless LANs, not for outdoors.

RADIO TRANSMISSION

- Easily generated, Omnidirectional, travels a long distance, and easily penetrates buildings.
- Frequency range: 300GHz to 3kHz.
- Radio waves are widely used for a variety of wireless communication applications, including AM/FM radio broadcasting, Wi-Fi, Bluetooth, and many short-range wireless technologies.
- PROBLEMS: frequency dependent, relatively low bandwidth for data communication, tightly licensed by the government.

MICROWAVE TRANSMISSION

- Microwaves provide a high-speed signal transmission. Widely used for long-distance communication, relatively inexpensive.
- Frequency range: 300MHz to 300GHz.
- Applications: cellular networks and satellite communication.
- PROBLEMS: don't pass through buildings, weather and frequency dependent.

Comparison of Frequencies

Transmission Type	Frequency Range
Infrared	300 GHz to 400 THz
Microwave	300 MHz to 300 GHz
Radio	300 GHz to 3 kHz

Communications Satellite

- A communications satellite is a space station that receives microwave signals from an earth-based station, amplifies (strengthens) the signals, and broadcasts the signals back over a wide area to any number of earth-based stations.

Wi-Fi

- Wi-Fi short for “wireless fidelity” is a short-range wireless digital standard aimed at helping portable computers and handheld wireless devices to communicate at high speeds and share internet connections at distances of 100–228 feet.
- You can find Wi-Fi connections, which operate at 2.4–5 gigahertz, inside offices, airports, and internet cafés, that have set up transmitters on rooftops, distributing wireless connections throughout their neighborhoods.

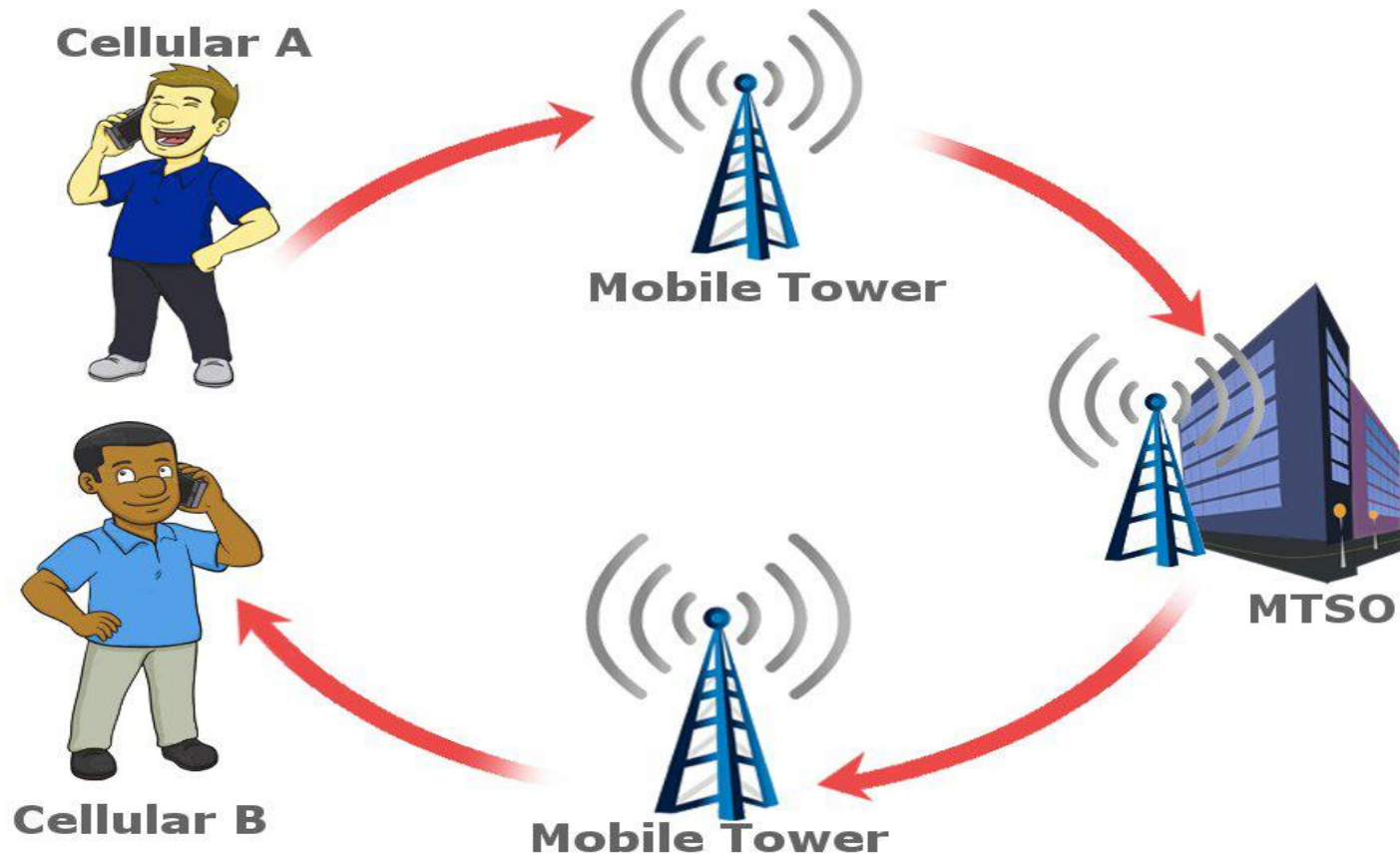
MOBILE CELLULAR NETWORKS

Mobile Cellular Networks are a type of wireless communication system that enables mobile devices, such as smartphones, tablets, and cellular-enabled laptops, to connect to the internet and communicate with each other by establishing radio connections through a network of cell sites.

Key Components of Mobile Networks

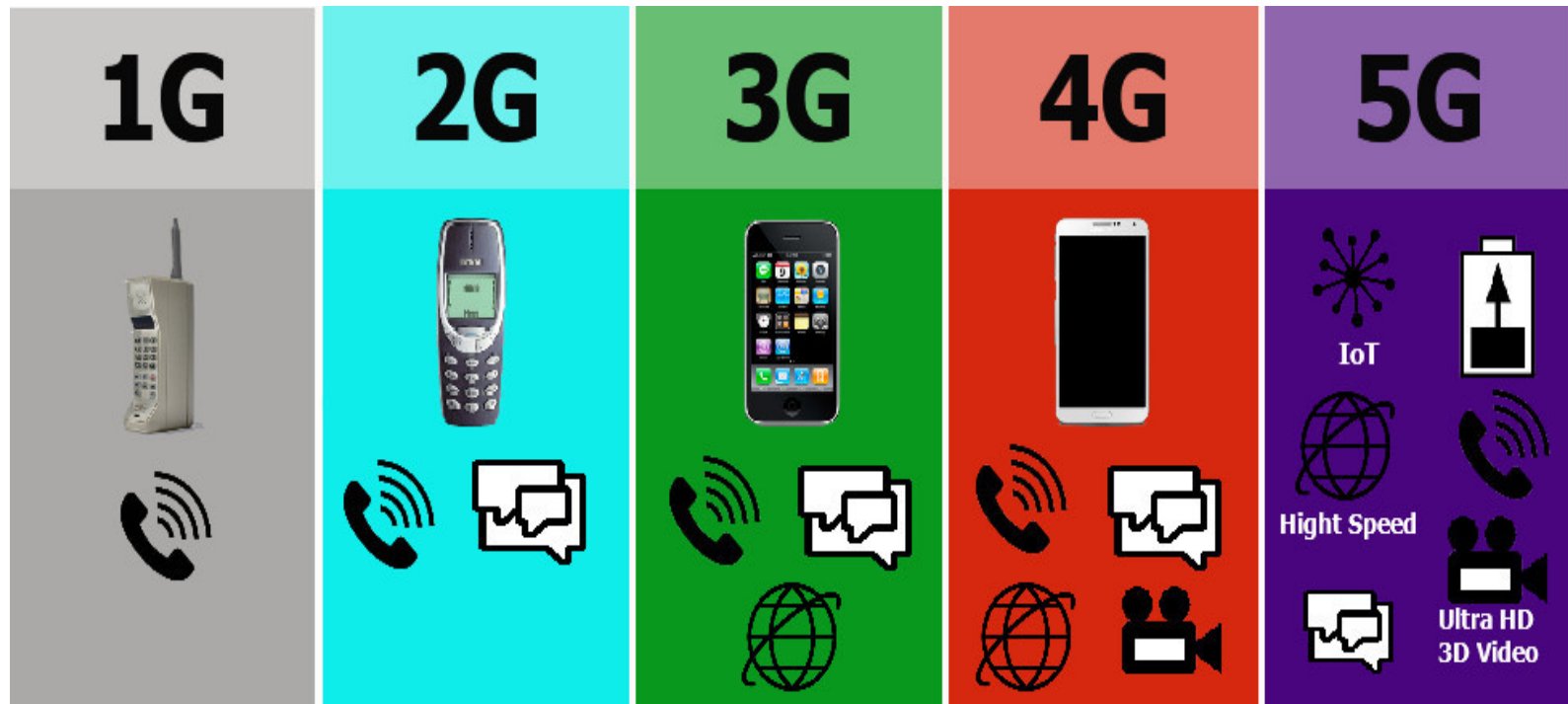
- **Cell Sites:** These are the base stations that transmit and receive signals to and from mobile devices.
- **Frequency Bands:** Mobile networks use specific frequency bands for communication. Different bands have different properties.
- **Cellular Infrastructure:** This includes network switches, routers, and data centers for managing and routing calls and data.
- **Subscriber Identity Module (SIM) Cards:** These small cards contain user information and are essential for network authentication.

MOBILE NETWORK



Generation Evolution

Each generation brought advancements in data speed, capacity, and capabilities.



1G TECHNOLOGY

- 1G refers to the first generation of wireless telephone technology, mobile telecommunications which was first introduced in the 1980s and completed in early 1990s.
- A channel capacity of 30KHz.
- Its Speed was up to 2.4kbps.
- It allows the voice calls in 1 country.
- 1G network use Analog Signal.

DRAWBACKS OF 1G

- Poor Voice Quality
- Poor Battery Life
- Large Phone Size
- No Security
- Limited Capacity
- Poor Handoff Reliability

2G Technology

- 2G technology refers to the 2nd generation which is based on GSM(Global System for Mobile Communication).
- It was launched in Finland in the year 1991.
- 2G network use digital signals.
- Its data speed was up to 64kbps.

Features Includes:

- It enables services such as text messages, picture messages, and MMS (multimedia messages).
- It provides better quality and capacity.

DRAWBACKS OF 2G

- 2G requires strong digital signals to help mobile phones work. If there is no network coverage in any specific area , digital signals would weak.
- These systems are unable to handle complex data such as Videos.

3G TECHNOLOGY

- 3G technology refers to the third generation which was introduced in year 2000s.
- Data Transmission speed increased from 144kbps- 2Mbps.
- Typically called Smart Phones and features increased its bandwidth and data transfer rates to accommodate web-based applications and audio and video files.

FEATURES OF 3G TECHNOLOGY

- Providing Faster Communication
- Send/Receive Large Email Messages
- High-Speed Web / More Security Video Conferencing / 3D Gaming
- TV Streaming/ Mobile TV/ Phone Calls
- Large Capacities and Broadband Capabilities
- 11 sec – 1.5 min. time to download a 3 min MP3 song.

DRAWBACKS OF 3G TECHNOLOGY

- Expensive fees for 3G Licenses Services.
- It was challenge to build the infrastructure for 3G.
- High Bandwidth Requirement.
- Expensive 3G Phones.
- Large Cell Phones.

4G TECHNOLOGY

- 4G technology refers to or short name of the fourth Generation which was started in the late 2000s.
- Capable of providing 100Mbps – 1Gbps speed.
- One of the basic term used to describe 4G is MAGIC.
- MAGIC:
 - ✓ Mobile Multimedia
 - ✓ Anytime Anywhere
 - ✓ Global Mobility Support
 - ✓ Integrated Wireless Solution
 - ✓ Customized Personal Services

DRAWBACKS OF 4G

- Battery use is more
- harder to implement
- Need complicated hardware
- Expensive equipment required to implement next-generation network

5G TECHNOLOGY

- 5G technology refer to short name of fifth Generation which was started from late 2010s.
- Complete wireless communication with almost no limitations. It is highly supportable to WWW (Wireless World Wide Web).

BENEFITS OF 5G TECHNOLOGY

- High Speed, High Capacity
- Provide large broadcasting of data in Gbps.
- Multimedia Newspapers, watch T.V programs with the clarity as to that of an HD Quality.
- Faster data transmission than that of the previous generations.
- Large Phone Memory, Dialing Speed, and clarity in Audio/Video.
- Support interactive multimedia, voice, streaming video, Internet and other.

INTERNET OF THINGS

- The Internet of Things (IoT) is a concept that refers to the interconnection of everyday physical objects, devices, and machines to the Internet, allowing them to collect and exchange data, make autonomous decisions, and perform various tasks without human intervention.

APPLICATIONS

IoT has a wide range of applications in various industries, including:

- **Smart Homes:** Smart lighting, security systems, and voice assistants.
- **Smart Cities:** Traffic management, waste management, and public safety.
- **Healthcare:** Remote patient monitoring and medical device connectivity.
- **Agriculture:** Precision farming and livestock monitoring.
- **Manufacturing:** Industrial automation and predictive maintenance.
- **Transportation:** Vehicle telematics and logistics optimization.

Challenges and Concerns in IOT

- IoT raises several challenges, including data privacy and security issues. As more devices are connected, the potential for vulnerabilities and cyberattacks increases. Additionally, there are concerns about data ownership and the potential misuse of data.