

# Mobile Devices and Computing

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Introduction

# Modern Mobile Communication System

Main components & systems



Handhelds



Cell Tower

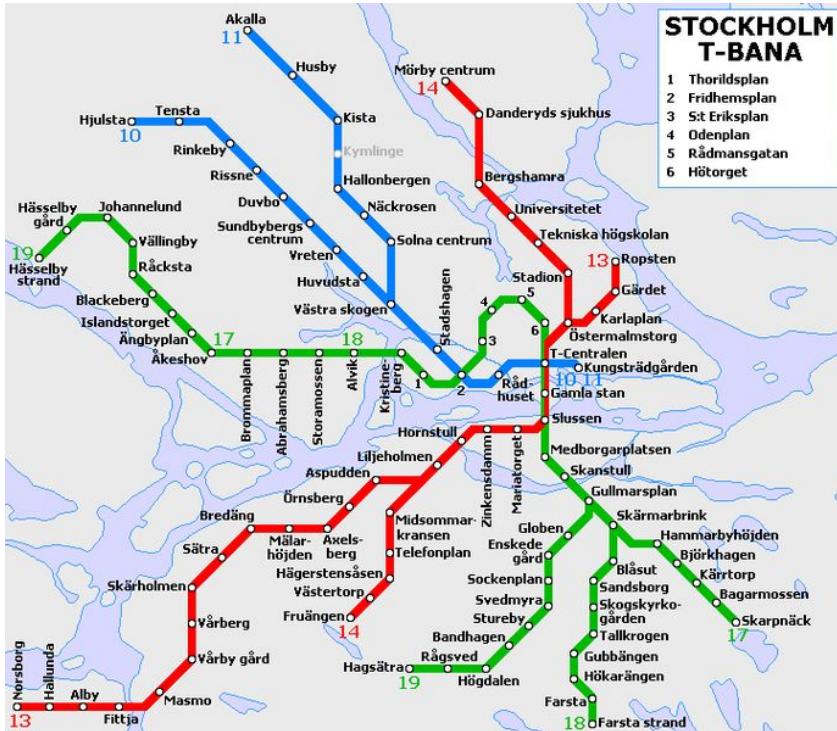


Internet

# 4G Wireless Communication Network



# Transport Network (Metro Map)

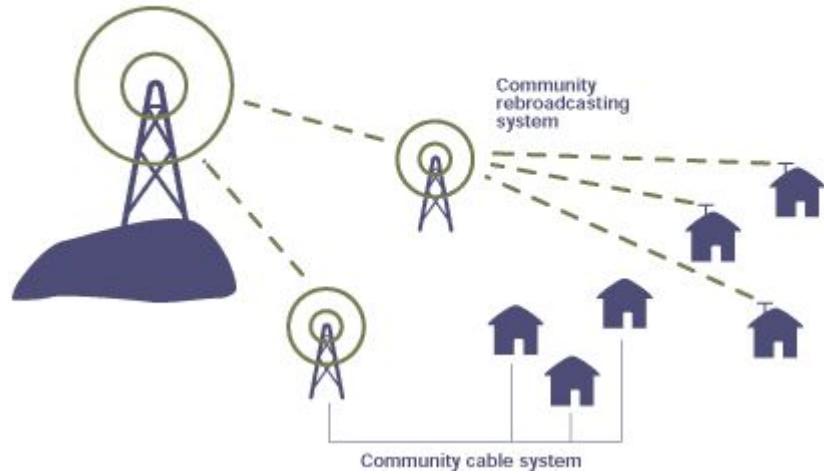


## Stations

Central Junctions - Main Transmitter/Repeater  
Sub junction - Base Station  
Terminals - Terminals

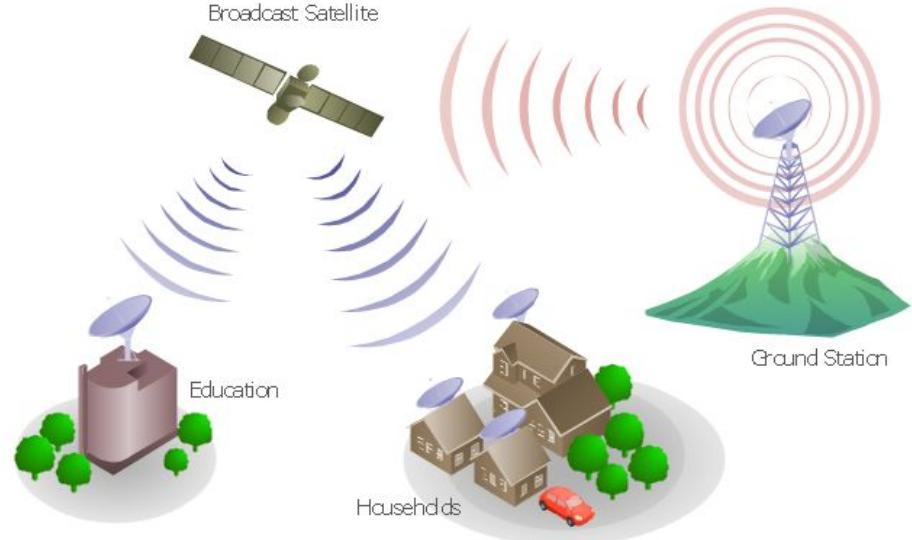
# Radio Systems - Backbone of Comm.

*Terrestrial 'off air' Feed*



Terrestrial

Broadcast Satellite



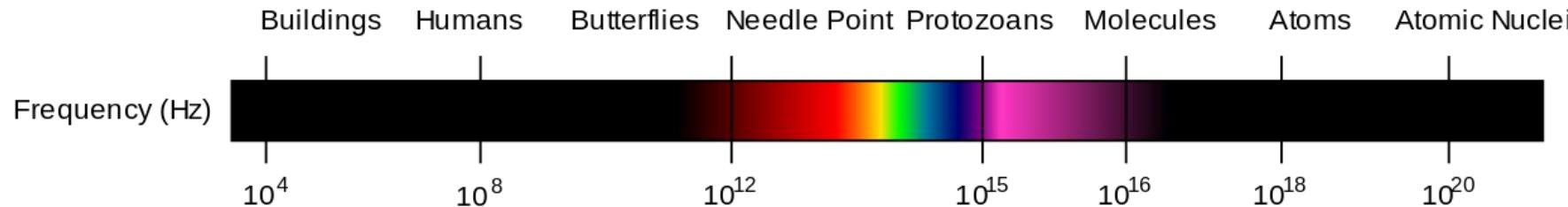
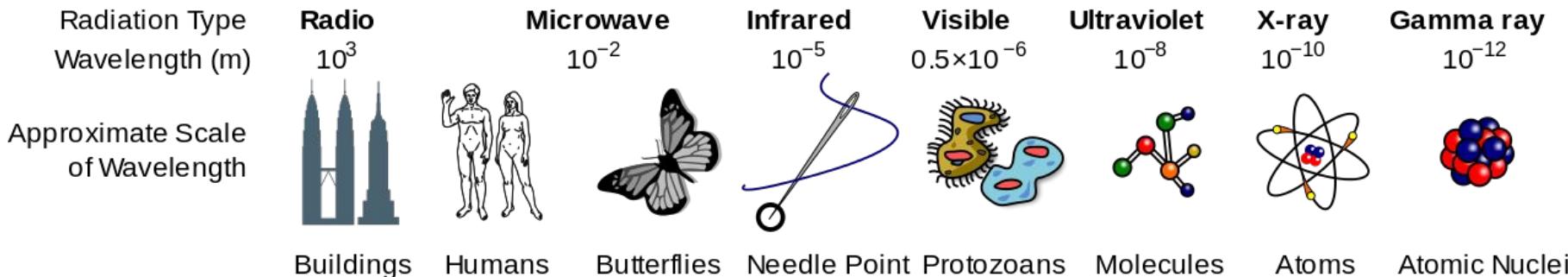
Satellite

Refs: <https://www.hitechmv.com/wp-content/uploads/2014/05/terrestrial-11.gif>;  
<https://www.conceptdraw.com/examples/telecommunication-rf-diagram>

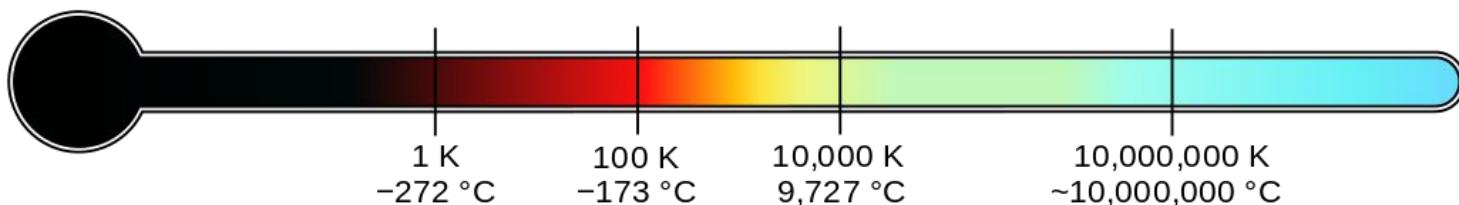
Penetrates Earth's Atmosphere?



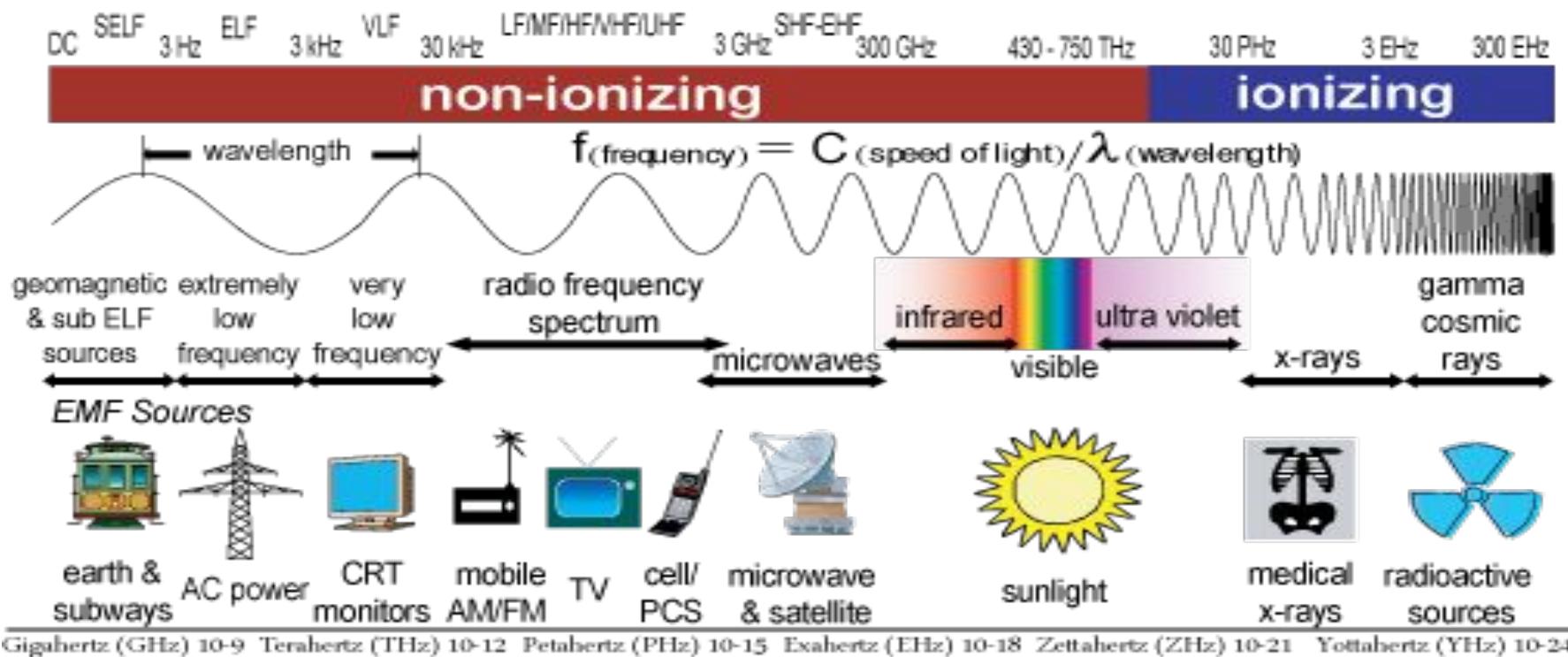
# Electromagnetic Spectrum



Temperature of objects at which this radiation is the most intense wavelength emitted

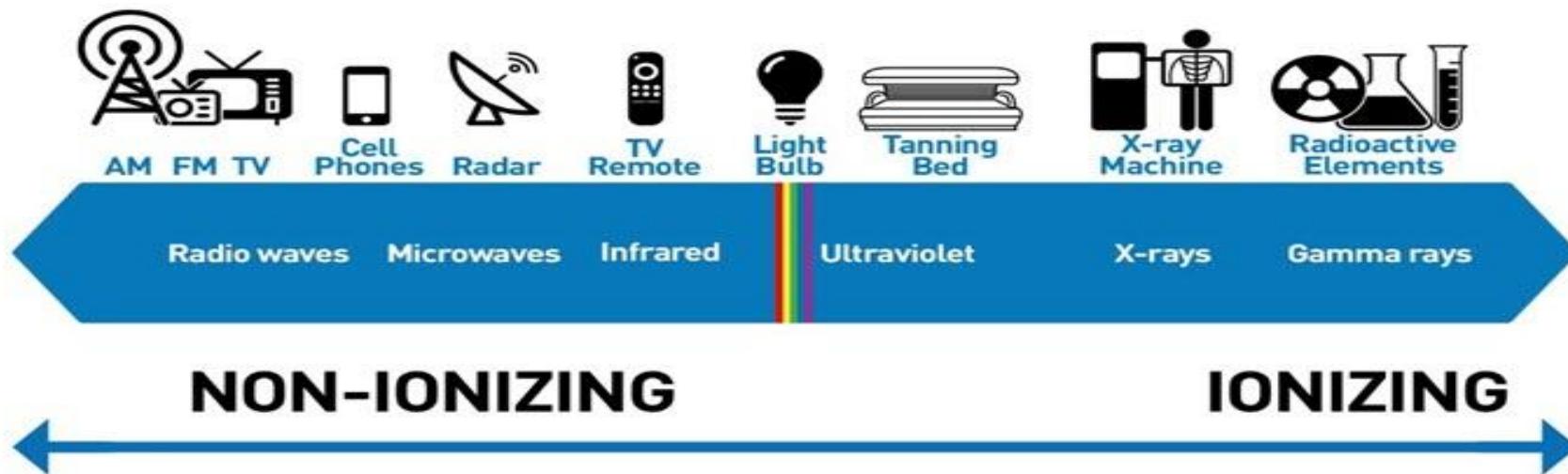


# THE ELECTROMAGNETIC SPECTRUM



# IONIZATION

## Electromagnetic Spectrum



# Conventional Radio - 1920s - Audio - ( $\leq$ ) 5kHz



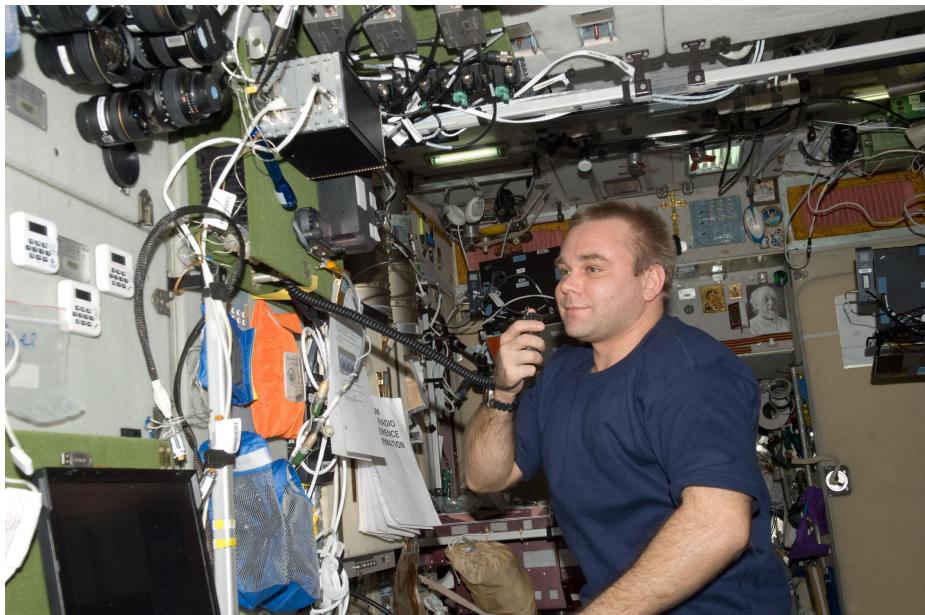
Evolution of radio to podcast <https://visual.ly/community/Infographics/history/history-radio>

# Television = Radio + Visuals 1930s - 50MHz

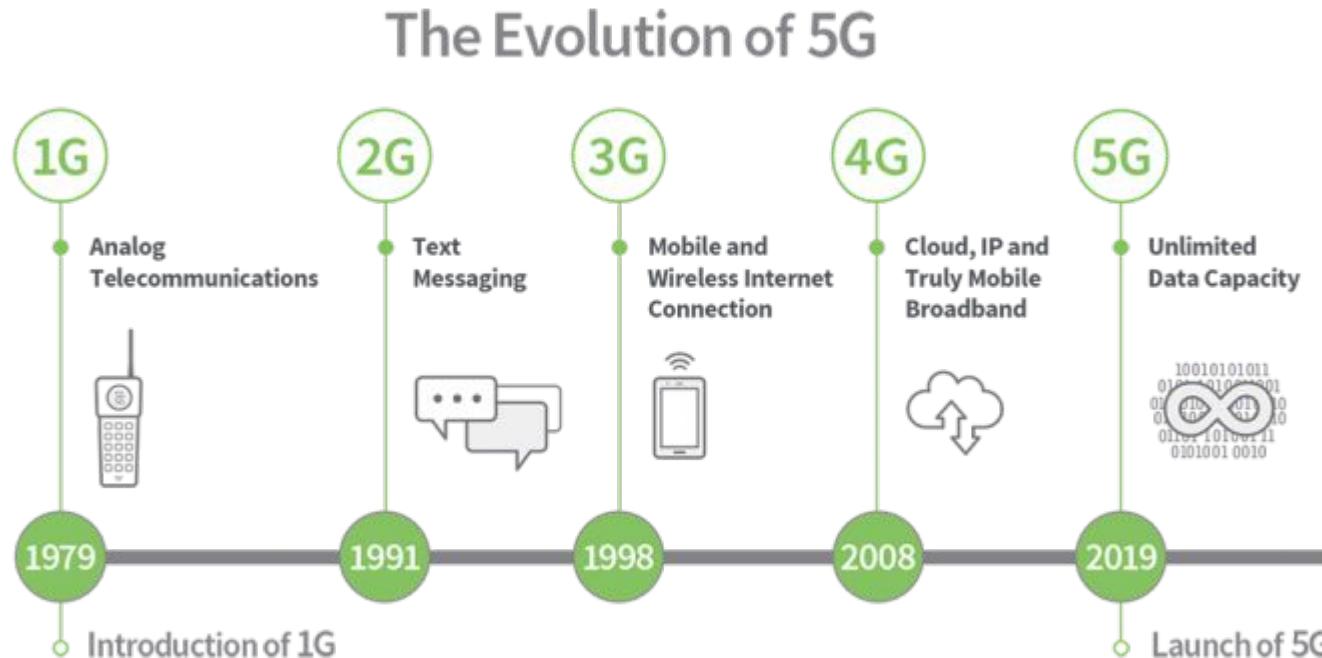


Evolution: <https://visual.ly/community/Infographics/technology/televisions-six-eras>

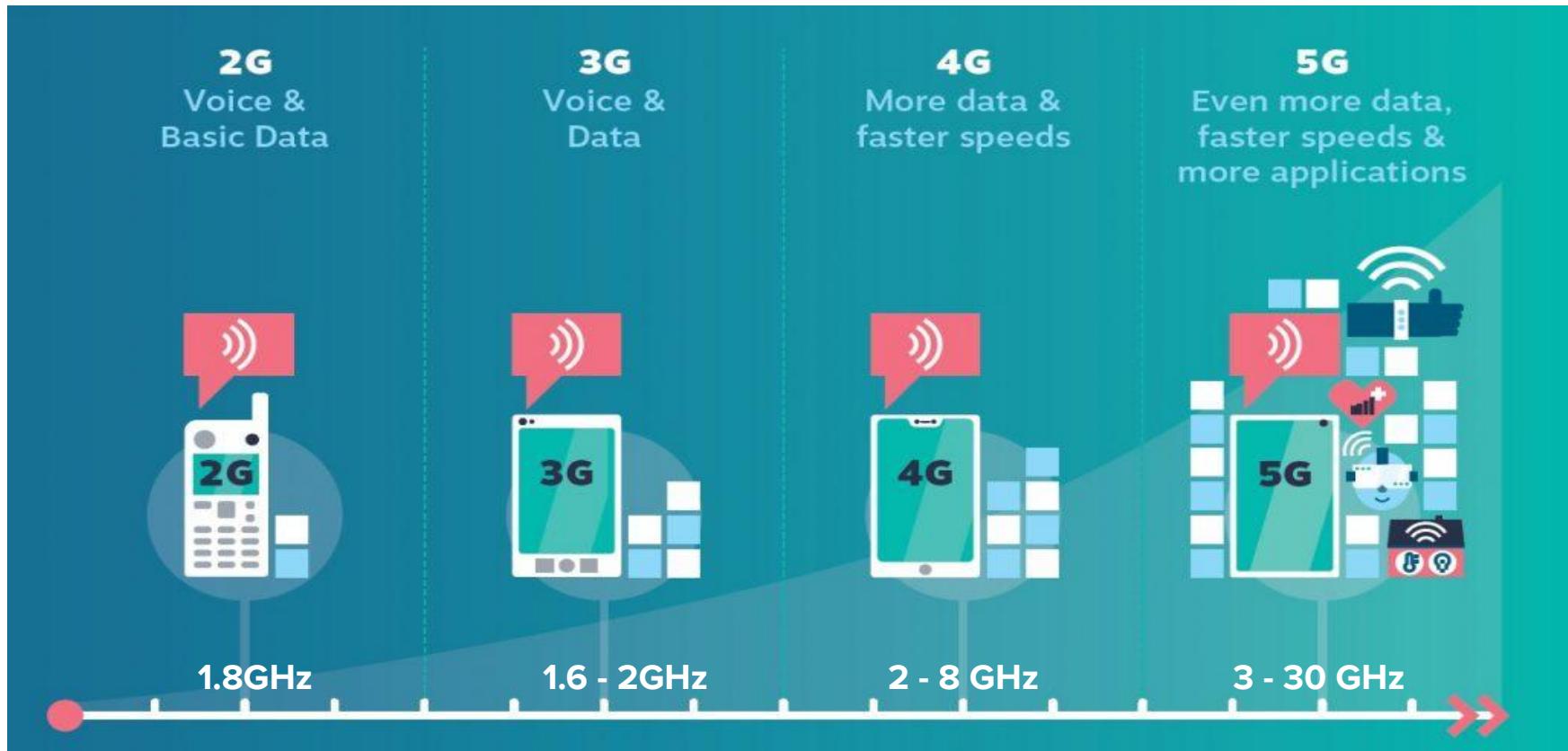
# Digital Packet Radio - Low GHz



# Evolution of wireless communication technology



# Cell Phone - <= 30GHz



# Wireless LAN & Wifi Internet - 802.11 std. - 2 to 60 GHz



Access Point



Wifi



WLAN Modems

# Cell Phone Technology

- A Modern History of Human Communication
- Cell Phone Usage Statistics
- Cell Phone Traffic: Data vs. Voice
- Cell Phone Device Technology

# Evolution of Mobile Phones

Early phones were bulky, inefficient and limited in functionality



1973 - 2006



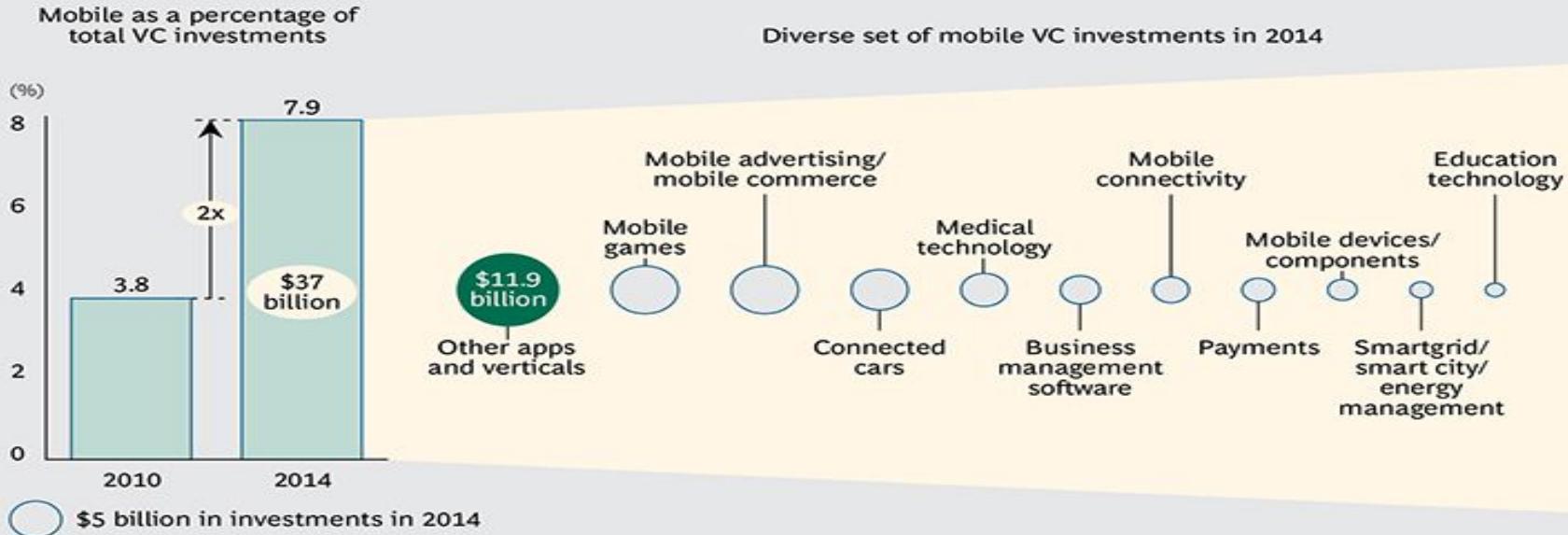
2007 - 2016

Ref: <https://studentwork.prattsi.org/infovis/visualization/evolution-of-mobile-phone/>

Ref: <https://www.iphonelife.com/content/evolution-iphone-every-model-2007-2016>

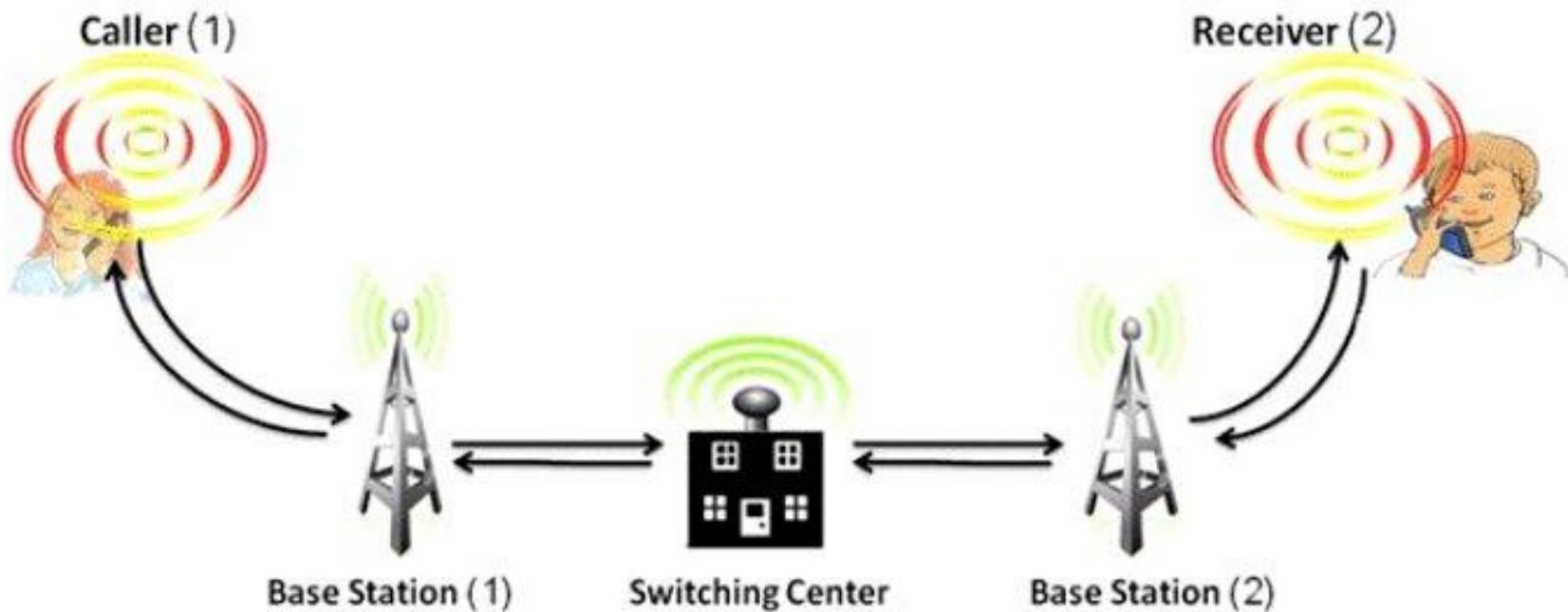
# Market Importance

## **EXHIBIT 5 | Venture Capital Investments in Mobile Are Growing Rapidly**



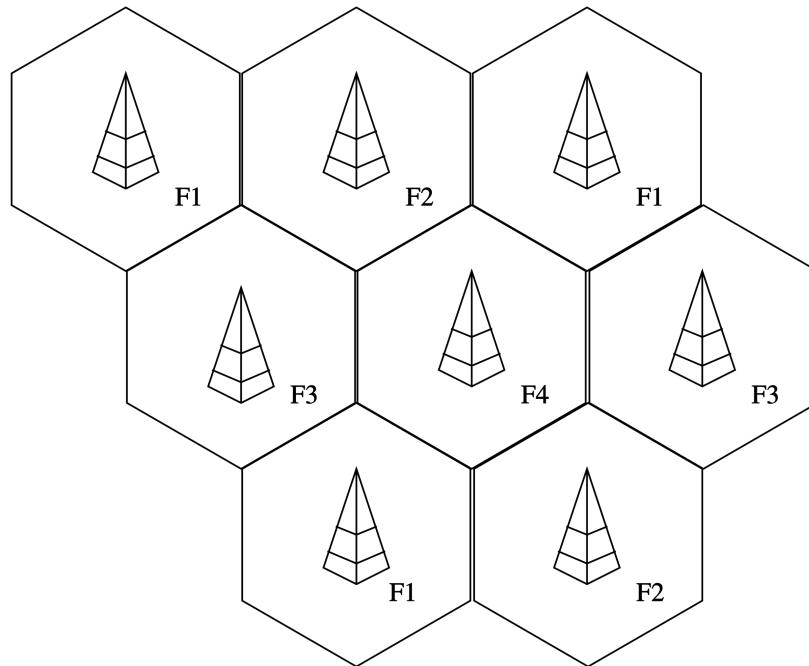
Sources: Quid private-investment database; Capital IQ; BCG analysis.

# Working of a Cell Phone Call



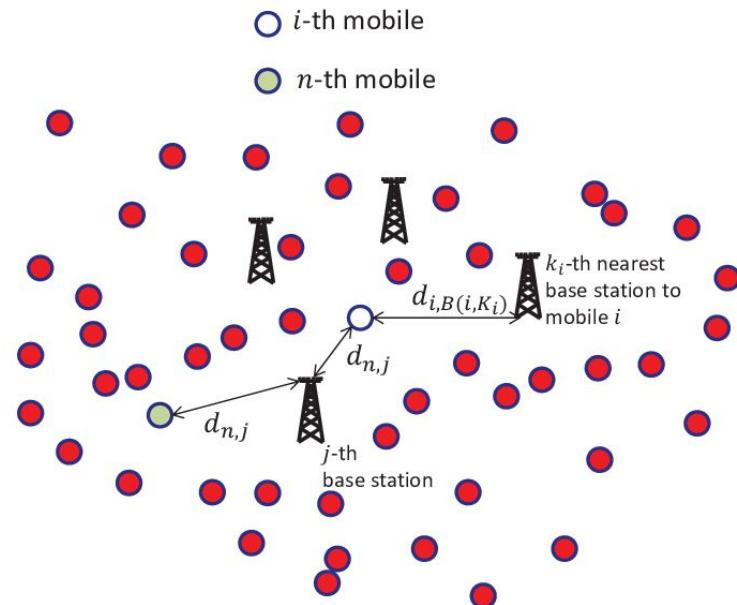
# First step

The system divides the service areas into a set of cells or geographical zones



# Second Step

Mobile phone sends out radio signals Based on the time delay between the phone and the base station - the nearest station is identified

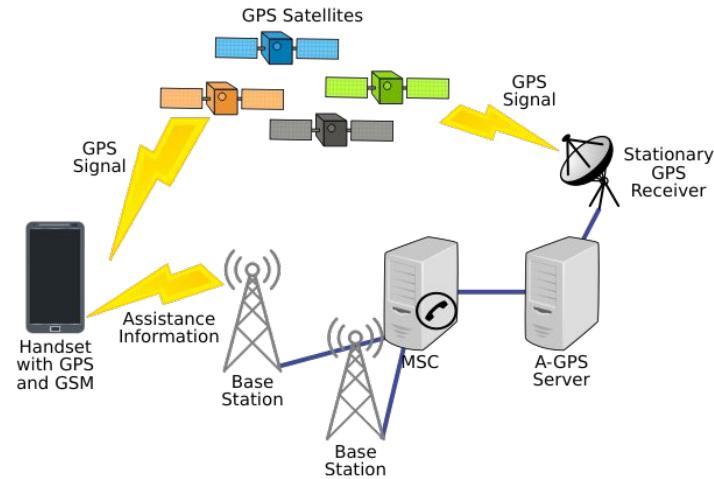


# Third Step

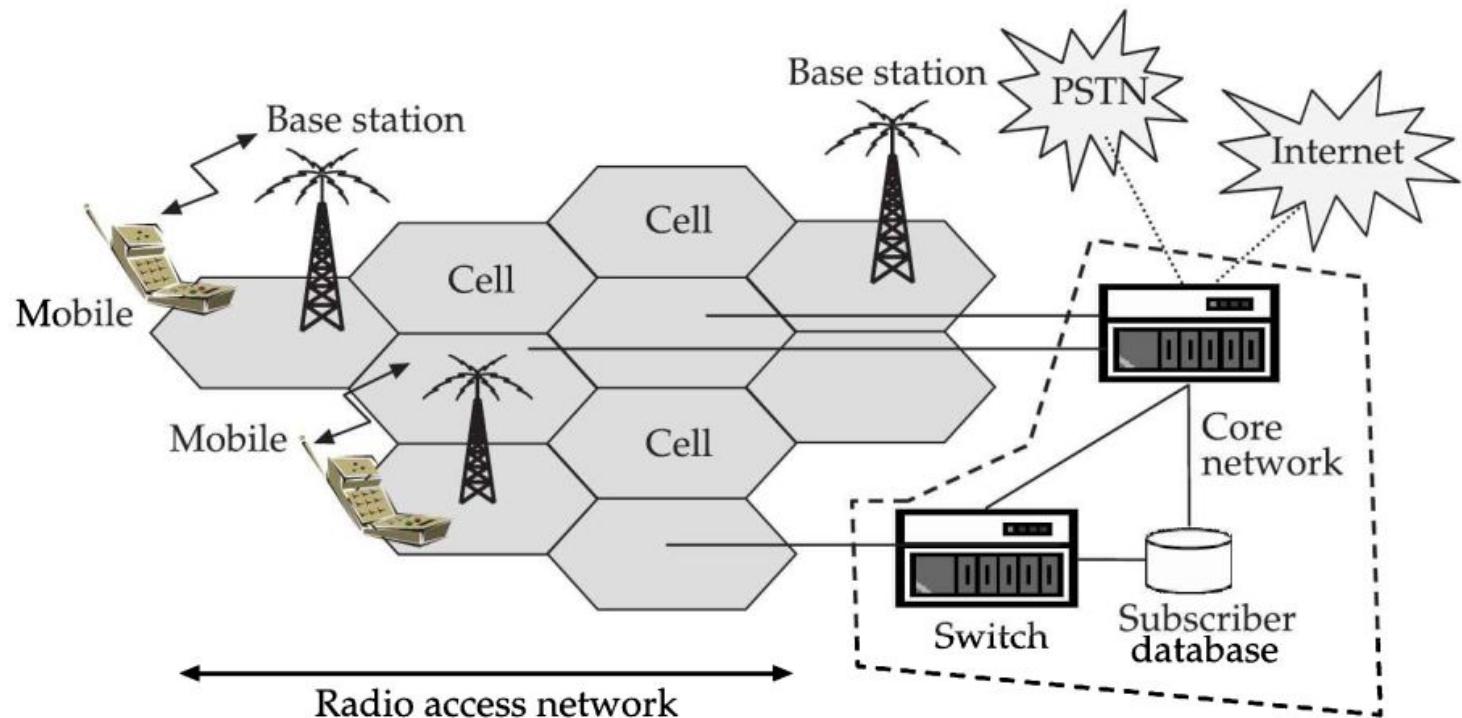
Base station contacts the mobile switching center

The MSC - middleman - to mediate a call between the caller and the receiver

When a user is moving, the MSC hands over the call to nearest base station



# Architecture of mobile telecommunications system



# Radio Access Network

- Communication link between the mobile phone and the base station - occurs through radio waves
- Radio waves - EM waves of large wavelengths
- The shape of each cell is a hexagon
- Improves the distance between base station and the mobile phone
- Comm. Channel - A radio link between the phone antenna and the base station antenna or between two base stations and so on
- Control Channel - control messages - for e.g. making a call - FSK
- Voice Channel - voice messages - for actual conversations - FM

# Radio Access Network Contd.

- Base station - two antennas - one for transmitting signals (high power) - other for receiving signals (very lower power)
- Signals - waves or some form of EM energy - carrying information and function of space and time
- Antennas - require greater power for transmission due to inverse square law - receive little power due to same law
- Handheld device - one antenna - for both transmitting and receiving signals
- One antenna - saves power and space

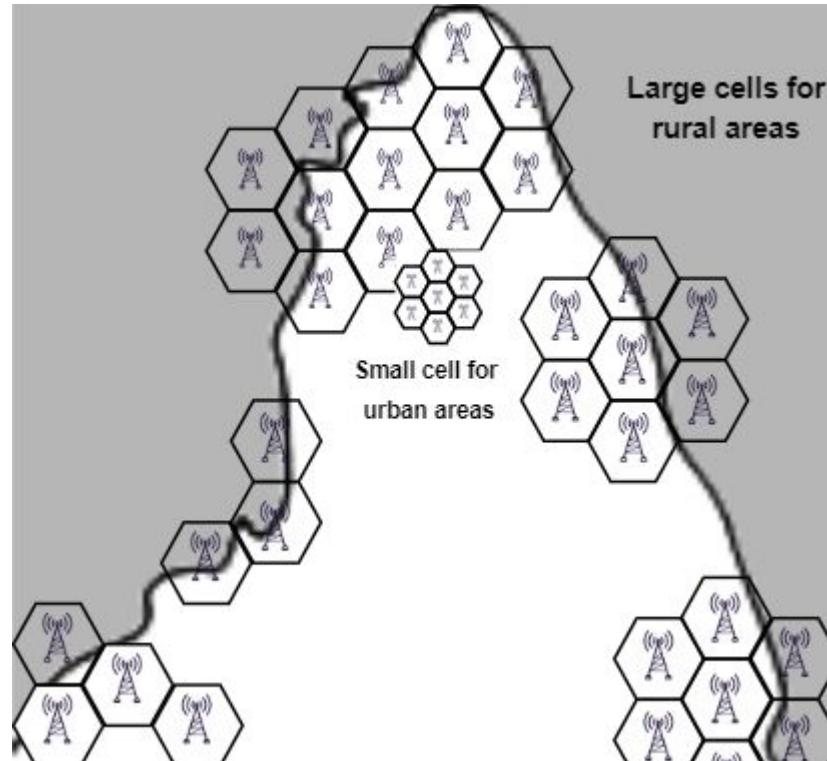
# Considerations in Urban Area vs Rural Area

## Advantages

- Because cells are smaller, system capacity increases. Also, less power is used by mobiles and Base Stations.

## Disadvantages

- Handoffs become more common. To prevent handoffs and dropped calls, umbrella cells are needed for high speed traffic.
- Many new base stations are needed, increasing system complexity and load of MSC.
- Since all channels are not split simultaneously, special care have to be taken for proper allocation of the channels.





# Core Network

- Local base station contacts the Mobile Switching Center
- When a user is moving the MSC handles the allocation of base station - user
- Roaming - when a user travels outside the home network his service is handled by a partner network (**PSTN - Public Switched Telephone Network**)
- Backbone - Roaming is possible because of underground wired network - using fiber optics
- When the terrain is challenging - microwave links are used - Satellites can also be used for long distance communication
- MSC is also connected to local telephone network - enable communication with traditional phone networks and users
- Routing of voice and message calls is also handled
- Database consists of subscriber information and billing information