

# **Mobile System From Where to Where?**

**By**

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# Introduction

- ❖ One of the fastest growing and most demanding communication industries is mobile telecommunications, The stages of evolution and development of these systems are known as “**generations**”.

# History of wireless communication

- 1895      Guglielmo Marconi
  - first demonstration of wireless telegraphy (digital!)
  - long wave transmission, high transmission power necessary (> 200kw)
- 1907      Commercial transatlantic connections
  - huge base stations (30 - 100m high antennas)
- 1915      Wireless voice transmission New York - San Francisco
- 1920      Discovery of short waves by Marconi
  - reflection at the ionosphere
  - smaller sender and receiver, possible due to the invention of the vacuum tube (1906, Lee DeForest and Robert von Lieben)
- 1926      Train-phone on the line Hamburg - Berlin
  - wires parallel to the railroad track



# Evolution of Mobile Radio Communications

- Major Mobile Radio Systems
  - 1934 - Police Radio uses conventional AM mobile communication system.
  - 1935 - Edwin Armstrong demonstrate FM
  - 1946 - First public mobile telephone service - push-to-talk
  - 1960 - Improved Mobile Telephone Service, IMTS - full duplex
  - 1960 - Bell Lab introduce the concept of Cellular mobile system
  - 1968 - AT&T propose the concept of Cellular mobile system to FCC.
  - 1976 - Bell Mobile Phone service, poor service due to call blocking
  - 1983 - Advanced Mobile Phone System (AMPS), FDMA, FM
  - 1991 - Global System for Mobile (GSM), TDMA, GMSK
  - 1991 - U.S. Digital Cellular (USDC) IS-54, TDMA, DQPSK
  - 1993 - IS-95, CDMA, QPSK, BPSK



**Wireless Telegraph**



**Walkie Talkie**



**Cordless Phone**



**Cell Phone**

## History - Mobile Communications

- 1911 mobile transmitter on Zeppelin
- 1926 train (Hamburg – Berlin)
- 1927 first commercial car radio (receive only)
- First Mobile Communication Systems started in the 40s in the US and in the 50s in Europe



1924

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<http://www.bell-labs.com/history/75/gallery.html>

### CONCEPTS:

- Large Areas per Transmitter
- „Mobiles“ large, high power consumption
- Systems low capacity, interference-prone
- Expensive !!!

# Overview of Mobile Development

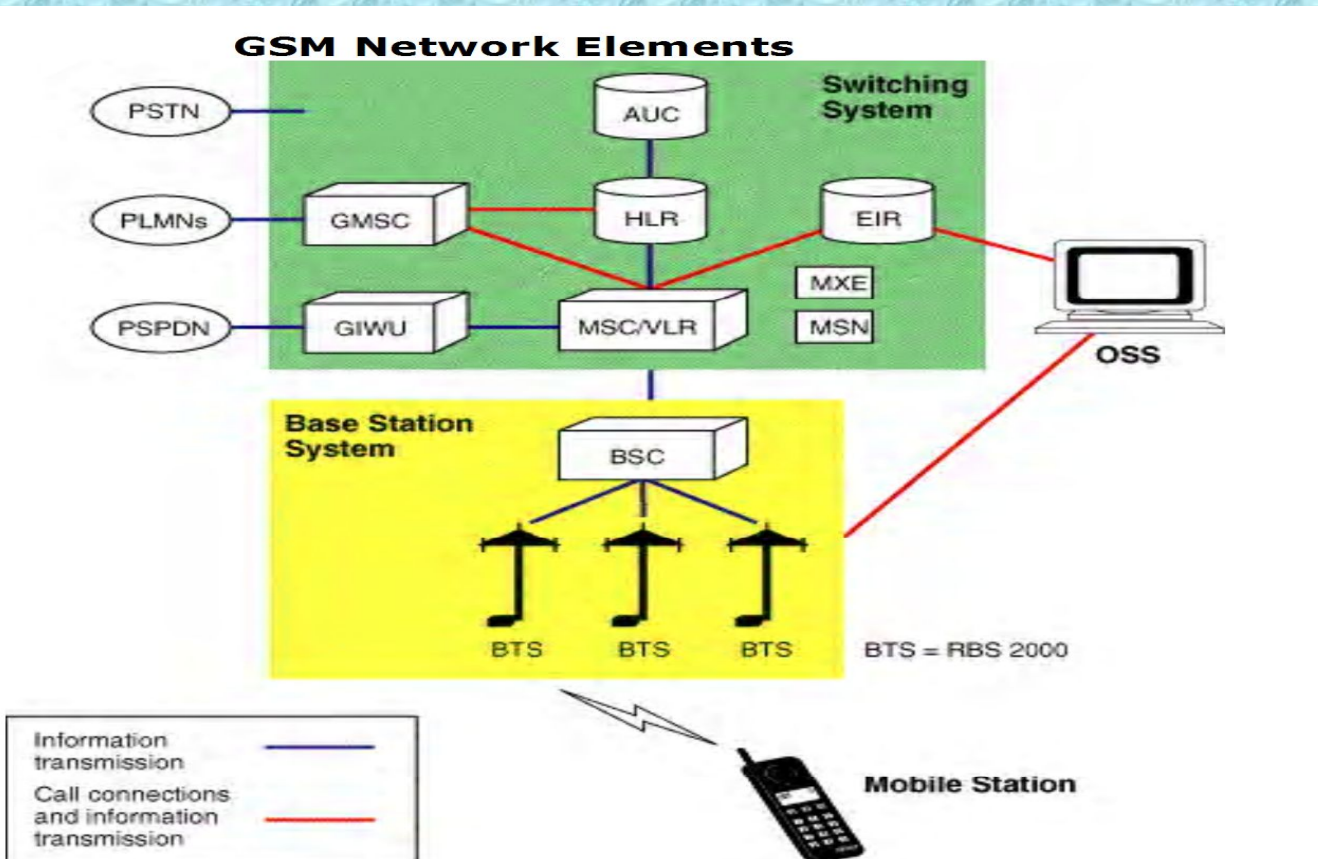
- 1) **1G system:** This process began with the designs in the 1970s , the earliest systems were implemented based on analog technology and the basic cellular structure of mobile communication.

## 1G Devices



## 2) 2G (GSM) system :

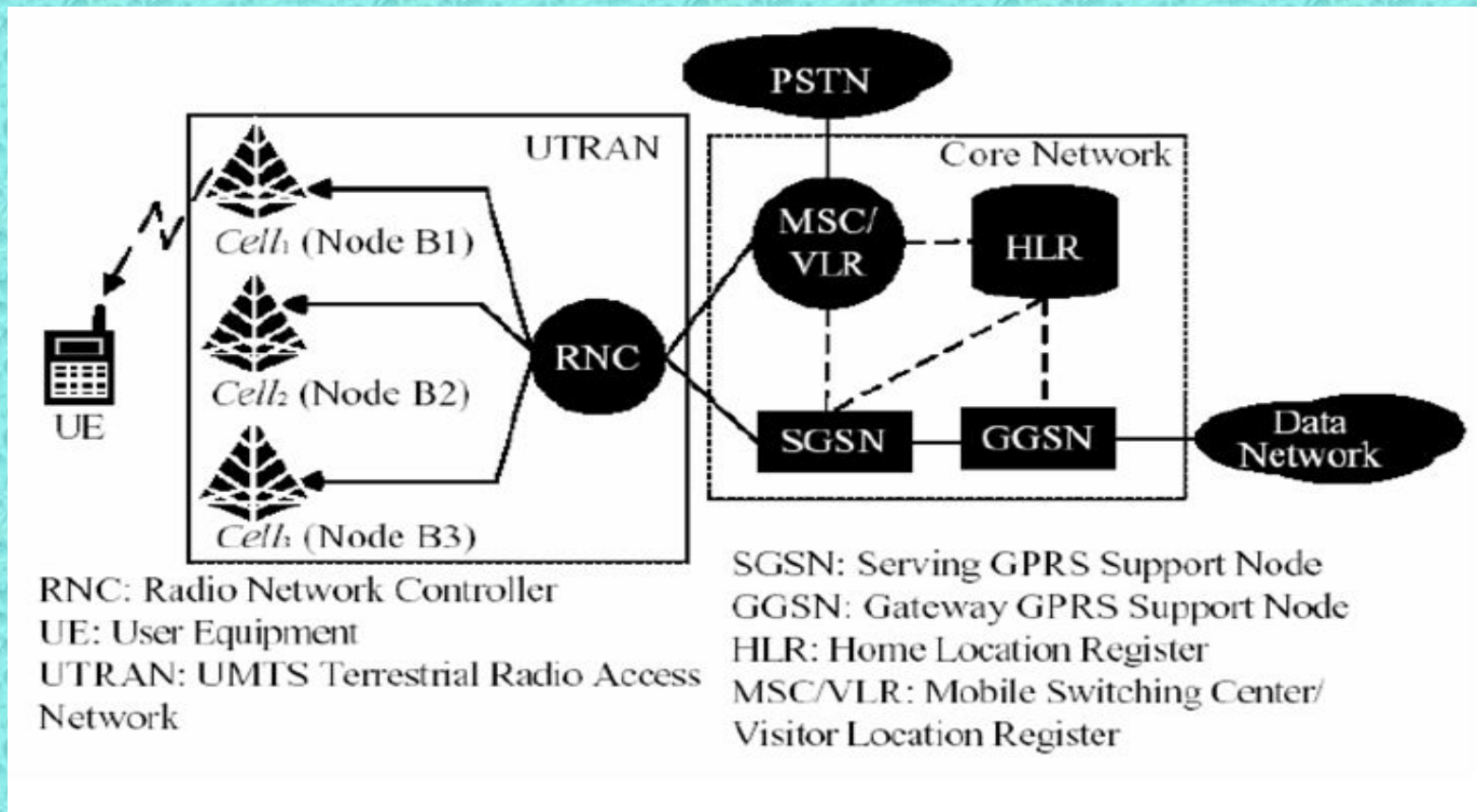
- Global system for mobile communications (GSM) were first used in the early 1990s in Europe.
- GSM provides voice and limited data services.
- GSM uses digital modulation (GMSK).
- Some examples of 2G are Digital AMPS, CDMA



### 3) 2.5G system :

# 2G + GPRS = 2.5G

### 4) 3G (UMTS) system :



# Three Generations



## 4G Mobile Expected Specifications and Services



Is the future mobile system beyond 3G that may have the following specifications:

- ✓ High-speed transmission (peak 50–100 Mbps, average 200 Mbps), 100 Mbps and 1 Gbps in outdoor and indoor environments respectively.
- ✓ Larger capacity (~10 times greater than 3G systems)
- ✓ Next-generation Internet support (IPv6, QoS)
- ✓ Flexible network architecture
- ✓ Use of microwave band (2 - 8 GHz)
- ✓ Low system costs (1/10~1/100 of 3G systems)

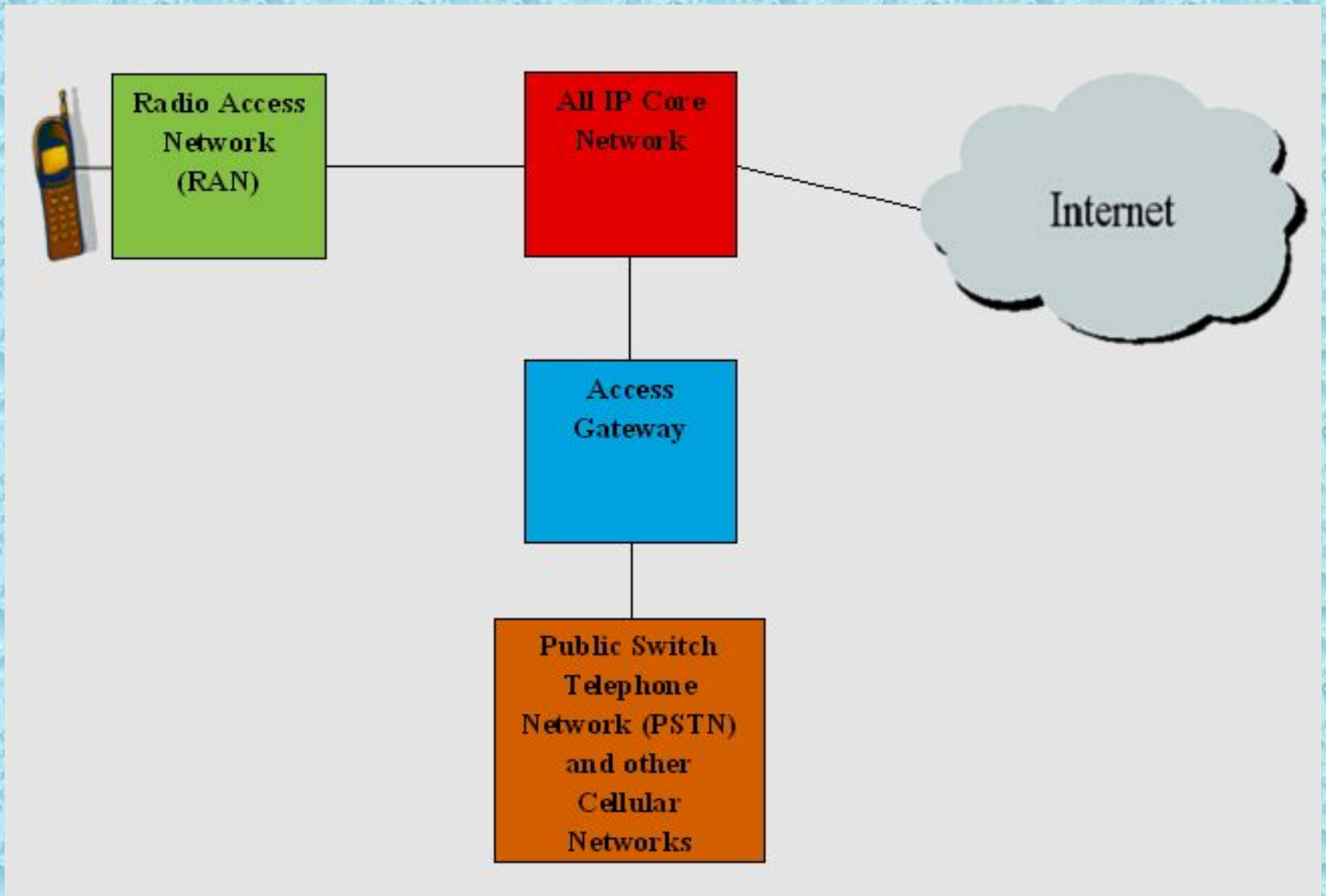
❖ The term 4G is used broadly to include several types of broadband wireless access communications systems, not only cellular telephone systems.

❖ One of terms used to describe 4G is :

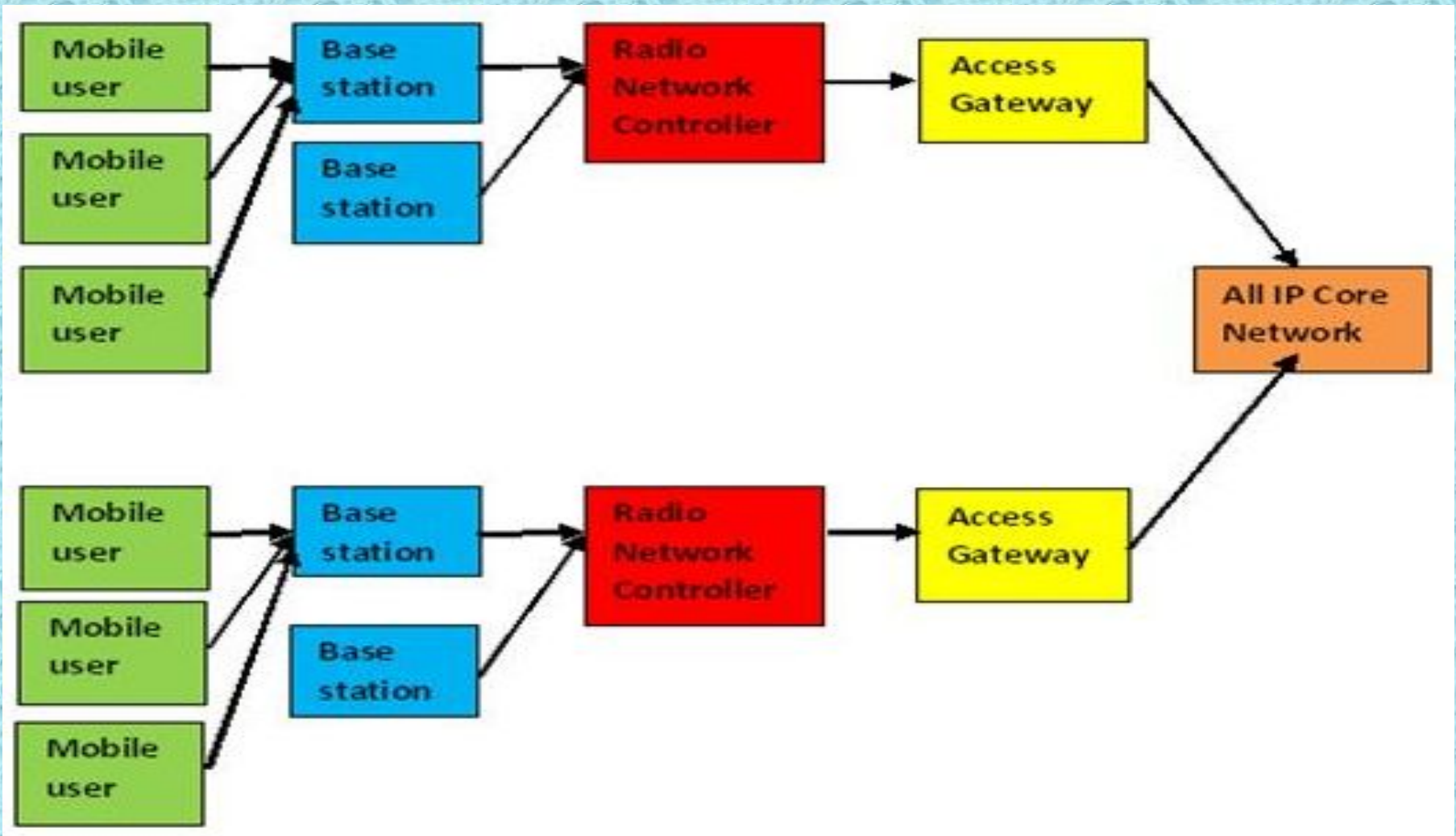
- MAGIC** :
- **M**obile multimedia
  - **A**ny time anywhere
  - **G**lobal mobility support
  - **I**ntegrated wireless solution and
  - **C**ustomized personal service

❖ The fourth generation of mobile networks will truly turn the current mobile phone networks, into end to end IP based networks, if 4G is implemented correctly, it will truly harmonize global roaming.

# 4G Mobile Proposed Architecture



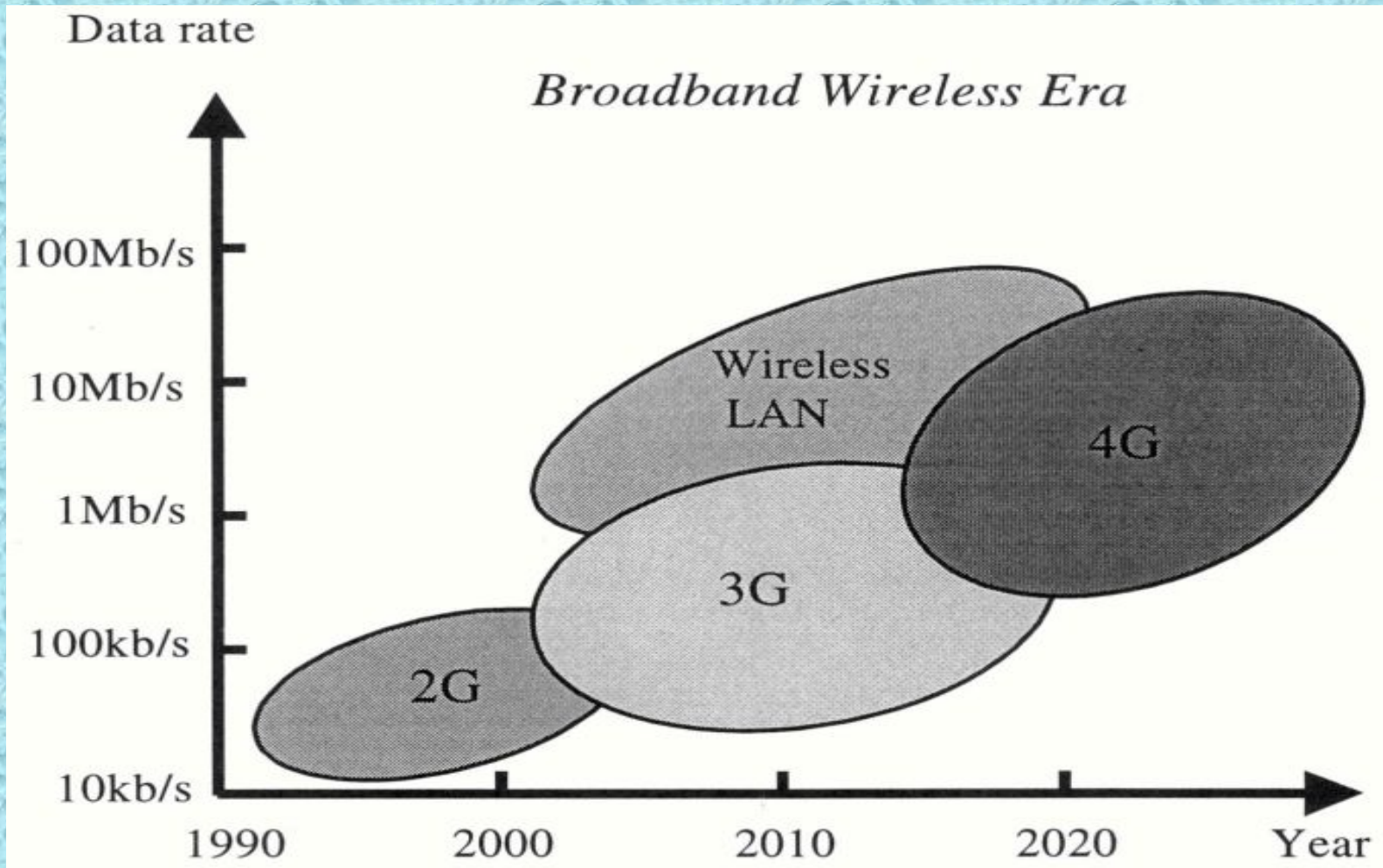
# Simplified 4G Radio Access Network (RAN) architecture



# Major Mobile Standards

<b>Generation</b>	<b>Year of service</b>	<b>Major systems</b>	<b>Peak data rate</b>
<b>1G</b>	<b>1983</b>	<b>AMPS</b>	
<b>2G</b>	<b>1991</b>	<b>GSM,  PDC, IS-54,  IS-95</b>	<b>13 kbps  8 kbps  9.6 kbps</b>
<b>3G</b>	<b>2001-2004</b>	<b>WCDMA, CDMA2000,  EDGE</b>	<b>2M bps</b>
<b>4G</b>	<b>2015 or after</b>	<b>MC-CDMA /  OFDM-based?</b>	<b>&gt;100 Mbps?</b>

# Rate for Different Generations as a Function of Year



# Frequency-Related Specifications of Mobile Systems

<b>System</b>	<b>UL frequency band (MHz)</b>	<b>DL frequency band (MHz)</b>	<b>Bandwidth (MHz)</b>	<b>Channel Spacing (kHz)</b>	<b>No.of channels</b>	<b>Duplex distance (MHz)</b>
<b>P-GSM900</b>	<b>890-915</b>	<b>935-960</b>	<b>25</b>	<b>200</b>	<b>125</b>	<b>45</b>
<b>E-GSM900</b>	<b>880-915</b>	<b>925-960</b>	<b>35</b>	<b>200</b>	<b>175</b>	<b>45</b>
<b>GSM1800</b>	<b>1710-1785</b>	<b>1805-1880</b>	<b>75</b>	<b>200</b>	<b>375</b>	<b>95</b>
<b>GSM1900</b>	<b>1850-1910</b>	<b>1930-1990</b>	<b>60</b>	<b>200</b>	<b>300</b>	<b>80</b>
<b>UMTS</b>	<b>1920-1980</b>	<b>2110-2170</b>	<b>60</b>	<b>5000</b>	<b>12</b>	<b>90</b>
<b>LTE</b>	<b>2110-2170</b>	<b>2300-2360</b>	<b>60</b>	<b>5000</b>	<b>12</b>	<b>290</b>

# Some 4G devices





**Thank you**