How Cellphones Work

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1. INTRODUCTION

A cellphone is really an extremely sophisticated radio. Telephone was invented by Alexander Graham Bell in 1876 and wireless communication system or radio was invented in 1894 by Guglielmo Marconi. In a cell phone, these two technologies have been combined.

Before cell phones came into existence, people who required mobile communication had radio telephones installed in their cars. In the radio telephone system, there is one central antenna tower per city, and about 25 channels available on that tower. This central antenna meant that the phone in the car needed a powerful transmitter big enough to transmit over a distance of 40 to 50 miles. It also limited the number of people who could use the radio telephones because there were not enough channels.

2. CELLULAR SYSTEM

The cellular system divides a city into small cells, allowing extensive frequency reuse across a city, thus enabling millions of people to use cellphones simultaneously. In a typical analog cellphone system, the carrier receives about 800 frequencies to use in the city. The carrier divides the city into cells. Each cell is typically sized at about 26 square kilometres. Cells are divided into a hexagonal grid. Because cellphones and base stations use low-power transmitters the same frequencies can be reused in non-adjacent cells. Each cell has a base-station that consists of a tower and a small building containing the radio equipment.

A single cell in an analog system uses one seventh of the available duplex voice channels. In other words, one cell, plus the six cells around it in the hexagonal grid, each uses one seventh of the available channels. Therefore, each cell has a unique set of frequencies and collisions can be avoided.

A cellphone carrier gets approximately 832 radio frequencies to use in the city. Each cellphone uses two frequencies per call - a duplex channel - so there are typically 395 voice channels per carrier. Therefore, each cell has about 56 voice channels available, so that in any cell, 56 people can be talking on their cell phones at one time. With digital transmission methods, the number of available channels increases. ATDMA-based digital system can carry three times as many calls as an analog system, so each cell would have about 168 channels available.

The cellular scheme requires a large number of base stations in a city. A city can have hundreds of towers. Each carrier in each city also runs one central office called the Mobile Telephone Switching Office (MTSO) which handles all the phone connections to the normal land based phone system, and controls all the base stations in the region.

3. CELLPHONES

Cellphones have low-power transmitters in them. Many cellphones have two signal strengths : 0.6 watts and 3 watts.

With low-power transmitters the same frequencies can be reused extensively across the city. The power consumption of the cellphone, mostly battery-operated, is relatively low. Low power means small batteries, and this is what has made handheld celluler phones possible.

All cellphones have special codes associated with them, which identify the phone, the phone's owner and the service provider. When you first power up the phone, it listens for an SID (Subscriber Identification Date) on the control channel. The control channel is a special frequency that the phone and base station use to talk to one another for call set up and channel-changing. If the phone cannot find any control channel to listen to, it knows it is out of range, and displays a "no network" message. When it receives the SID, the phone compares it to the SID programmed into the phone. If the SIDs match, the phone knows that the

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cell it is communicating with is part of its home system. Along with the SID, the phone also transmits a registration request , and the MTSO keeps track of your phone's location in a database – this way, the MTSO knows which cell you are in when it wants to ring your phone. The MTSO gets the call, and it tries to find you. It looks in its database to see which cell you are in. The MTSO picks a frequency pair that your phone will use in that cell to take the call. The MTSO communicates with your phone over the control channel to tell it what frequencies to use, and once your phone and the tower switch on those frequencies, the call is connected. You begin talking to your contact.

If the SID on the control channel does not match the SID programmed into your phone, then the phone knows it is roaming. The MTSO of the cell you are roaming in contacts the MTSO of your home system, which then checks its database to confirm that the SID of the phone you are using is valid. Your home system verifies your phone to the local MTSO, which then tracks your phone as you move through its cells. All this happens in a jiffy.

Digital cellphones use the same radio technology as analog phones but in a different way. Analog systems do not fully utilise the signal between the phone and the cellular network. Analog signals cannot be compressed and manipulated as easily as a digital signal. This is also true of cable companies that are going digital so that they can fit more channels within a given band width.

Digital systems are much more efficient. Digital phones convert the voice into binary information (1s and 0s) and then compress it. This compression allows between three to ten cellphone calls to occupy the space of a single analog cellphone voice call.

GSM is the international standard in Europe, Australia and much of Asia and Africa. In these areas, cell-phone-users can buy one phone that will work anywhere else the standard is supported. To connect to the specific service providers in these different countries, GSM-users simply switch subscriber indentification module (SIM) cards. SIM cards are small removable disks that slip in and out of GSM cellphones. They store all the connection data and identification numbers you need to access a particular wireless service provider.

The 1900 MHZ GSM phones used in the United States are not compatiable with the international system. You can pick up prepaid SIM cards for a wide range of countries at Telestial. com.

A cellphone, like any other gadget, can break. Non-repairable internal corrosion of parts results if you get the phone wet or use wet hands to press the buttons. So a protective case is essential. If the phone does get wet, make sure it is dry before you switch it on to avoid damaging internal parts.

Cracked display screens can occur when an overflowing briefcase squeezes the cellphone. Extreme heat in a car can damage the battery or the cellphone electronic circuit. Extreme cold may cause a momentary loss of the screen display. Analog cellphones suffer from a problem known as "cloning". A phone is "cloned" when someone steals its ID numbers and is able to make fraudulent calls on the owner's account.

Cellphones are one of the most intricate devices people use on a daily basis. Modern digital cellphones can process millions of calculations per socond in order to compress and decompress the voice stream.

If you take a cellphone apart, you will find that it contains :

a) An amazing circuit board containing the brain of the phone

b) An antenna

c) A liquid crystal display (LCD)

d) A keyboard not unlike the one we see in a TV remote control

e) A microphone

f) A speaker

g) A battery

The microprocessor does all the work for the keyboard and display, deals with command and control signaling with the base station, and also coordinates the rest of the functions on the board. The ROM and flash memory clips provide storage for the phone's operating system

and customizable features, such as the phone directory. The RF and power section handles power management and recharging, and also deals with the hundreds of FM channels. Finally, the RF (Radio Frequency) amplifiers handle signals in and out of the antenna. Cellphones have tiny speakers and microphones and it is incredible to think how well most of them reproduce sound. Isn't it amazing that the functions that would have been performed by equipment filled in an entire floor of a building can now be packaged to fit your palm?

3. How to choose a cellphone

The list of features that should be kept in mind while purchasing a cellphone are as follows :

Service plan : Before you buy a particular model of cellphone you should decide on the service plan that suits you.

Mode : Are you looking for analog or digital? Do you prefer PCS (Personal Communication Services) or cellula.? Look for dual mode/dual band phones if you travel a lot.

Battery type : Cellphones use two main types of battery : NiMH (Nickel Metal Hydride) - high capacity battery that provides extra power for extended use. Li-ion (Lithium Ion) - has a lot of power in a light weight package but usually costs more than NiMH batteries. Check to see how long the battery takes to recharge and whether a rapid charger is available.

Display : All cellphones have LCD displays, but the specific features of the display can vary. A large multiline display is typically more expensive but necessary if you plan to use the phone for wireless internet. Most cellphones have monochrome display (16 grays), but a few are beginning to appear that have colour. Cellphones with colour screens need more memory and tend to be more expensive. Almost all cellphones have backlit screens, which are good for low light conditions.

Functions : Most good cellphones offer all of these features while more economical phones may only have a few :

- Phone Directory
- Clock
- Calculator
- Games
- Personalised/custom sounds
- Appointment Reminder/Calender
- Incoming number storage
- Automatic redial
- Last number recall
- Mute/hold button
- One touch dialling/speed dialling
- Vibrate mode
- Lock/ Alarm
- Call forwarding
- Multiparty Calls
- E-mail/ text messaging
- Minibrowser

Some Cellphones have special features such as :

- Wireless Internet
- Hands-free Headset/speaker-phone
- External volume/ringer control
- Rapid charger/built in charger
- Car adapter
- Modem function
- PC Synchronisation
- PDA (Personal Digital Assistants)
- MP3 Player
- GPS (Global Positioning System) receiver.

When looking at phones with a headset or a speakerphone connection, check to see if the plug is proprietary. If it is, then check the cost and availability of the headset or speakerphone. All phones come with a charger, but not all of them come with a rapid charger.

Size : Think about how you plan to use the phone. Will it mostly be a car phone? Or do you plan to carry it in a pocket all day long? This will help you determine if that cheaper phone with the same features is a better deal than the one that weighs little but costs more.

Price : Weigh the options carefully and make sure that you don't pay for features that you may never use. If you are not interested in wireless Internet, then you may not want to pay the extra money for a WAP-enabled phone.

There are few other things that you should be aware of when buying a cellular phone :

If you travel a lot, will your phone work in a different state or country?

This depends largely on whether your phone is analog, digital or both (dual-mode). With a digital signal, depending on your provider, your phone might work only over a certain region, or perhaps over your entire country. The problem is that there are several competing digital systems available and several different frequencies on each system. Ask your access provider for a map of exactly where the digital signal you will be accessing is available. If your phone is analog, it will probably work over most areas. However, when you use an analog signal, you are sacrificing a great amount of the features and clarity that have become common with a digital signal when available, or switch to an analog signal if necessary, and is thus the best option if you travel a great deal.

4. A FACTOR OF CAUTION

Several studies have been carried out that give conflicting results on the effects on the human body from the radiation given off by cellphones. The amount of radiation emitted from most cellphones is very minute. However, due to the close proximity of the phone to the head, it is possible for the radiation to cause harm. The easiest way to minimise the radiation you are exposed to is to distance the antenna as far from your head as possible.

5. CONCLUSION

The cell phone has redefined the communication technology by the multifarious facilities it provides to its users. Barring the subtle risks, it is perhaps the greatest invention of the 20th century that has made the world a small place to live in by transforming it into a 'global village'.

If you can dream — and
not make dreams your master;
If you can think — and
not make thoughts your aim;
If you can force your heart
and nerve and sinew;
If you can fill the unforgiving minute
with sixty seconds' worth of distance run —
Yours is the earth and
Everything there's in it.

—Rudyard Kipling