# MOBILE COMMUNICATION: CELL PHONE

**INTRODUCTION**

One of the most common sights we see these days is that of people with their mobile phones next to their ears. It’s a boon for better communication. Mobile phones are low power radio devices that transmit and receive radio frequency radiation through an antenna used close to the user'shead. Digital systems have recently replaced analog.

Fascinated by the features available in today’s mobile phones, more interest is given on the usage of these features. In this process we are forgetting about some of the aspects like:

* Are our mobile phones safe to use?
* How to track a lost cell phone?

So the theme of this paper is to present the latest developments in mobile communication in general and in specific suggest a technology to detect lost mobiles and make you aware of the hazards caused by mobile phones and suggest some tips to overcome them.

**MOBILE PHONE**

A mobile phone (also called mobile, cellular phone, cell phone or hand phone) is an [electronic device](http://en.wikipedia.org/wiki/Electronic_device) used for [full duplex](http://en.wikipedia.org/wiki/Full_duplex) [two-way radio telecommunications](http://en.wikipedia.org/wiki/Mobile_telecommunications) over a [cellular network](http://en.wikipedia.org/wiki/Cellular_network) of [base stations](http://en.wikipedia.org/wiki/Base_station) known as [cell sites](http://en.wikipedia.org/wiki/Cell_site).

Mobile communications let you operate without the need for a fixed phone line giving your business greater operations flexibility, faster customer responsiveness and savings in staff time. A mobile phone allows its user to make and receive [telephone calls](http://en.wikipedia.org/wiki/Telephone_call) to and from the [public telephone network](http://en.wikipedia.org/wiki/PSTN) which includes other mobiles and [fixed line](http://en.wikipedia.org/wiki/Fixed_line) phones across the world. It does this by connecting to a [cellular network](http://en.wikipedia.org/wiki/Cellular_network) owned by a [mobile network operator](http://en.wikipedia.org/wiki/Mobile_network_operator). A key feature of the cellular network is that it enables seamless telephone calls even when the user is moving around wide areas via a process known as [handoff](http://en.wikipedia.org/wiki/Handoff) or handover.

In addition to being a [telephone](http://en.wikipedia.org/wiki/Telephone), modern mobile phones also support many additional [services](http://en.wikipedia.org/wiki/GSM_services), and [accessories](http://en.wikipedia.org/wiki/Mobile_phone_accessories), such as [SMS](http://en.wikipedia.org/wiki/Short_message_service) (or [text](http://en.wikipedia.org/wiki/Text_messaging)) messages, [email](http://en.wikipedia.org/wiki/Email), [Internet](http://en.wikipedia.org/wiki/Internet) access, gaming, [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth), [infrared](http://en.wikipedia.org/wiki/Infrared), [camera](http://en.wikipedia.org/wiki/Camera), [MMS](http://en.wikipedia.org/wiki/Multimedia_Messaging_Service) messaging, [MP3 player](http://en.wikipedia.org/wiki/MP3_player), [radio](http://en.wikipedia.org/wiki/Radio) and [GPS](http://en.wikipedia.org/wiki/GPS).

In the year 1990, 12.4 million people worldwide had cellular subscriptions. By the end of 2009, only 20 years later, the number of mobile cellular subscriptions worldwide reached approximately 4.6 billion, 300 times the 1990 number, penetrating the [developing economies](http://en.wikipedia.org/wiki/Information_and_communication_technologies_for_development) and reaching the [bottom of the economic pyramid](http://en.wikipedia.org/wiki/Bottom_of_the_pyramid).

**HISTORY**

In 1960, the world’s first partly *automatic* car phone system, *Mobile System* A (MTA), was launched in Sweden. MTA phones were composed of [vacuum tubes](http://en.wikipedia.org/wiki/Vacuum_tube) and [relays](http://en.wikipedia.org/wiki/Relay), and had a weight of 40 kg.

In 1962, a more modern version called *Mobile System B (MTB)* was launched, which was a [push-button telephone](http://en.wikipedia.org/wiki/Push-button_telephone), and which used [transistors](http://en.wikipedia.org/wiki/Transistors) in order to enhance the telephone’s calling capacity and improve its operational reliability.

The first hand held phone was demonstrated by [Martin Cooper](http://en.wikipedia.org/wiki/Martin_Cooper_%28inventor%29) of [Motorola](http://en.wikipedia.org/wiki/Motorola) in 1973, using a handset weighing in at two kilos.

FIRST GENERATION: CELLULAR NETWORKS

The first commercially automated cellular network (the [1G](http://en.wikipedia.org/wiki/1G) generations) was launched in Japan by [NTT](http://en.wikipedia.org/wiki/Nippon_Telegraph_and_Telephone) in 1979, initially in the metropolitan area of Tokyo. The main technological development that distinguished the First Generation mobile phones from the previous generation was the use of multiple cell sites, and the ability to [transfer calls from one site to the next](http://en.wikipedia.org/wiki/Handoff) as the user travelled between cells during a conversation.

In 1981, this was followed by the simultaneous launch of the [Nordic Mobile Telephone](http://en.wikipedia.org/wiki/Nordic_Mobile_Telephone) (NMT) system in [Denmark](http://en.wikipedia.org/wiki/Denmark), [Finland](http://en.wikipedia.org/wiki/Finland), [Norway](http://en.wikipedia.org/wiki/Norway) and [Sweden](http://en.wikipedia.org/wiki/Sweden).[[8]](file:///C:\Documents%20and%20Settings\Siva\Desktop\siva\Mobile_phone.htm#cite_note-7). NMT was the first mobile phone network featuring international [roaming](http://en.wikipedia.org/wiki/Roaming).

In 1984, [Bell Labs](http://en.wikipedia.org/wiki/Bell_Labs) developed modern commercial cellular technology which employed multiple, centrally controlled base stations (cell sites), each providing service to a small area (a cell). The cell sites would be set up such that cells partially overlapped.

The first generation wireless standards used plain TDMA and FDMA. In the wireless channels, TDMA proved to be less efficient in handling the high data rate channels as it requires large guard periods to alleviate the multipath impact. Similarly, FDMA consumed more bandwidth for guard to avoid inter carrier interference.

The technology in these early networks was pushed to the limit to accommodate increasing usage. The base stations and the mobile phones utilized variable transmission power, which allowed range and cell size to vary. As the system expanded and neared capacity, the ability to reduce transmission power allowed new cells to be added, resulting in more, smaller cells and thus more capacity. The evidence of this growth can still be seen in the many older, tall cell site towers with no antennae on the upper parts of their towers. These sites originally created large cells, and so had their antennae mounted atop high towers; the towers were designed so that as the system expanded—and cell sizes shrank—the antennae could be lowered on their original masts to reduce range.

AMPS were a first-generation [cellular](http://en.wikipedia.org/wiki/Cellular_network) technology that uses separate frequencies, or "channels", for each conversation. It therefore required considerable [bandwidth](http://en.wikipedia.org/wiki/Bandwidth_%28signal_processing%29) for a large number of users. AMPS cellular service operated in the 800 [MHz](http://en.wikipedia.org/wiki/MHz) [Cellular](http://en.wikipedia.org/wiki/Cellular_frequencies) [FM](http://en.wikipedia.org/wiki/FM) band.

In AMPS, the cell centers could flexibly assign channels to handsets based on signal strength, allowing the same frequency to be re-used in various locations without interference. This allowed a larger number of phones to be supported over a geographical area. AMPS pioneers fathered the term "cellular" because of its use of small hexagonal "cells" within a system.

AMPS have been replaced by newer digital standards, such as [Digital AMPS](http://en.wikipedia.org/wiki/Digital_AMPS), [GSM](http://en.wikipedia.org/wiki/GSM), and [CDMA2000](http://en.wikipedia.org/wiki/CDMA2000) which brought improved security as well as increased capacity.

**PRESENT TECNNOLOGIES**

SECOND GENERATION: DIGITAL NETWORKS

In the [1990s](http://en.wikipedia.org/wiki/1990s), the 'second generation' ([2G](http://en.wikipedia.org/wiki/2G)) mobile phone systems emerged, primarily using the [GSM](http://en.wikipedia.org/wiki/Global_System_for_Mobile_Communications) standard. Three primary benefits of 2G networks over their predecessors were that phone conversations were digitally encrypted; 2G systems were significantly more efficient on the spectrum allowing for far greater mobile phone penetration levels; and 2G introduced data services for mobile, starting with SMS text messages. 2G networks were built mainly for voice services and slow data transmission.

While radio signals on 1G networks are [analog](http://en.wikipedia.org/wiki/Analog_signal), and on 2G networks are [digital](http://en.wikipedia.org/wiki/Digital), both systems use digital signaling to connect the radio towers (which listen to the handsets) to the rest of the telephone system.

The first "modern" network technology on digital [2G](http://en.wikipedia.org/wiki/2G) (second generation) cellular technology was launched by [Radiolinja](http://en.wikipedia.org/wiki/Radiolinja) (now part of [Elisa Group](http://en.wikipedia.org/wiki/Elisa_Oyj)) in 1991 in [Finland](http://en.wikipedia.org/wiki/Finland) on the [GSM](http://en.wikipedia.org/wiki/GSM) standard.

Coinciding with the introduction of 2G systems was a trend away from the larger "brickle" phones toward tiny 100–200g hand-held devices, which soon became the norm. This change was possible through technological improvements such as more advanced batteries and more energy-efficient electronics, but also was largely related to the higher density of cellular sites caused by increasing usage levels. This decreased the demand for high transmission powers to reach distant towers for customers to be satisfied.

2G technologies can be divided into [TDMA](http://en.wikipedia.org/wiki/Time_division_multiple_access)-based and [CDMA](http://en.wikipedia.org/wiki/Code_division_multiple_access)-based standards depending on the type of [multiplexing](http://en.wikipedia.org/wiki/Multiplexing) used. The main 2G standards are:

* [GSM](http://en.wikipedia.org/wiki/GSM) (TDMA-based), originally from Europe but used in almost all countries on all six inhabited continents (Time Division Multiple Access).
* [IS-95](http://en.wikipedia.org/wiki/IS-95) *aka* [cdmaOne](http://en.wikipedia.org/wiki/IS-95) (CDMA-based, commonly referred as simply [CDMA](http://en.wikipedia.org/wiki/CDMA) in the US), used in the Americas and parts of Asia. Today accounts for about 17% of all subscribers globally.
* [PDC](http://en.wikipedia.org/wiki/Personal_Digital_Cellular) (TDMA-based), used exclusively in Japan
* [iDEN](http://en.wikipedia.org/wiki/IDEN) (TDMA-based), proprietary network used by [Nextel](http://en.wikipedia.org/wiki/Nextel) in the [United States](http://en.wikipedia.org/wiki/United_States) and [Telus Mobility](http://en.wikipedia.org/wiki/Telus_Mobility) in [Canada](http://en.wikipedia.org/wiki/Canada)
* [IS-136](http://en.wikipedia.org/wiki/IS-136) *aka* [D-AMPS](http://en.wikipedia.org/wiki/D-AMPS) (TDMA-based, commonly referred as simply 'TDMA' in the US), was once prevalent in the Americas but most have migrated to GSM.

2G also introduced the ability to access media content on mobile phones, when Radiolinja (now Elisa) in Finland introduced the downloadable ring tone as paid content. Finland was also the first country where advertising appeared on the mobile phone when a free daily news headline service on SMS text messaging was launched in 2000, sponsored by advertising.

### 2.5G

2.5G is a stepping stone between 2G and 3G cellular wireless technologies. The term "second and a half generation" is used to describe 2G-systems that have implemented a packet switched domain in addition to the circuit switched domain. It does not necessarily provide faster services because bundling of timeslots is used for circuit switched data services (HSCSD) as well.

The first major step in the evolution of GSM networks to 3G occurred with the introduction of General Packet Radio Service ([GPRS](http://en.wikipedia.org/wiki/GPRS)). CDMA2000 networks similarly evolved through the introduction of [1xRTT](http://en.wikipedia.org/wiki/1xRTT). So the cellular services combined with enhanced data transmission capabilities became known as '2.5G.'

**General packet radio service** (GPRS) is a [packet oriented](http://en.wikipedia.org/wiki/Packet_oriented) [mobile data service](http://en.wikipedia.org/wiki/Mobile_Data_Service) on the [2G](http://en.wikipedia.org/wiki/2G) and [3G](http://en.wikipedia.org/wiki/3G) [cellular communication](http://en.wikipedia.org/wiki/Cellular_communication) systems [global system for mobile communications](http://en.wikipedia.org/wiki/Global_System_for_Mobile_Communications) (GSM). It provides moderate-speed data transfer, by using unused [time division multiple access](http://en.wikipedia.org/wiki/Time_division_multiple_access) (TDMA) channels in the GSM system.

GPRS could provide data rates from 56 kbit/s up to 115 kbit/s. It can be used for services such as Wireless Application Protocol (WAP) access, Multimedia Messaging Service (MMS), and for Internet communication services such as email and World Wide Web access.

**CDMA2000 1X (IS-2000)**, also known as **1x** and **1xRTT**, is the core CDMA2000 wireless air interface standard. The designation "1x", meaning *1 times Radio Transmission Technology*, indicates the same RF bandwidth as [IS-95](http://en.wikipedia.org/wiki/IS-95): a [duplex](http://en.wikipedia.org/wiki/Duplex_%28telecommunications%29) pair of 1.25 MHz radio channels. 1xRTT almost doubles the capacity of IS-95 by adding 64 more traffic channels to the [forward link](http://en.wikipedia.org/wiki/Forward_link), [orthogonal](http://en.wikipedia.org/wiki/Orthogonality) to (in [quadrature](http://en.wikipedia.org/wiki/Quadrature_phase) with) the original set of 64.

The 1X standard supports packet data speeds of up to 153 [kbps](http://en.wikipedia.org/wiki/Data_rate_units#Kilobit_per_second) with real world data transmission averaging 60–100 kbps in most commercial applications. It can also be used for WAP, SMS & MMS services, as well as Internet access.

2.75G

GPRS networks evolved to [**EDGE**](http://en.wikipedia.org/wiki/EDGE) networks with the introduction of 8PSK encoding. Enhanced Data rates for GSM Evolution (EDGE) (also known as Enhanced [GPRS](http://en.wikipedia.org/wiki/GPRS) (EGPRS), or [IMT](http://en.wikipedia.org/wiki/IMT-2000) Single Carrier (IMT-SC), or Enhanced Data rates for Global Evolution) is a digital [mobile phone](http://en.wikipedia.org/wiki/Mobile_phone) technology that allows improved data transmission rates as a [backward-compatible](http://en.wikipedia.org/wiki/Backward-compatible) extension of [GSM](http://en.wikipedia.org/wiki/GSM). EDGE is considered a 3G radio technology and is part of [ITU](http://en.wikipedia.org/wiki/ITU)'s [3G](http://en.wikipedia.org/wiki/3G) definition. EDGE was deployed on GSM networks beginning in 2003 — initially by [Cingular](http://en.wikipedia.org/wiki/Cingular) (now AT&T) in the [United States](http://en.wikipedia.org/wiki/United_States).[[2]](file:///C:\Documents%20and%20Settings\Siva\Desktop\New%20Folder%20%284%29\Enhanced_Data_Rates_for_GSM_Evolution.htm#cite_note-1)

Through the introduction of sophisticated methods of coding and transmitting data, EDGE delivers higher bit-rates per radio channel, resulting in a threefold increase in capacity and performance compared with an ordinary GSM/GPRS connection.

The specification achieves higher data-rates (up to 236.8 kbit/s). In addition to [Gaussian minimum-shift keying](http://en.wikipedia.org/wiki/Gaussian_minimum-shift_keying) (GMSK), EDGE uses [higher-order PSK/8 phase shift keying](http://en.wikipedia.org/wiki/Phase_shift_keying#Higher-order_PSK) (8PSK) for the upper five of its nine modulation and coding schemes. EDGE produces a 3-bit word for every change in carrier phase. This effectively triples the gross data rate offered by GSM.

EDGE, like [GPRS](http://en.wikipedia.org/wiki/GPRS), uses a rate adaptation algorithm that adapts the modulation and coding scheme (MCS) according to the quality of the radio channel, and thus the bit rate and robustness of data transmission.

It can handle four times as much traffic as standard [GPRS](http://en.wikipedia.org/wiki/GPRS). EDGE meets the [International Telecommunications Union](http://en.wikipedia.org/wiki/International_Telecommunications_Union)'s requirement for a [3G](http://en.wikipedia.org/wiki/3G) network, and has been accepted by the [ITU](http://en.wikipedia.org/wiki/ITU) as part of the [IMT-2000](http://en.wikipedia.org/wiki/IMT-2000) family of [3G](http://en.wikipedia.org/wiki/3G) standards.

THIRD GENERATION: HIGH SPEED DATA NETWORKS

As the use of 2G phones became more widespread and people began to utilize mobile phones in their daily lives, it became clear that demand for data services (such as access to the internet) was growing. Furthermore, experience from fixed broadband services showed there would also be an ever increasing demand for greater data speeds. The 2G technology was nowhere near up to the job, so the industry began to work on the next generation of technology known as 3G.

International Mobile Telecommunications-2000 (IMT--2000)**,** better known as 3G or 3rd Generation, is a generation of standards for [mobile phones](http://en.wikipedia.org/wiki/Mobile_phone) and [mobile telecommunications](http://en.wikipedia.org/wiki/Mobile_telecommunications) services fulfilling specifications by the [International Telecommunication Union](http://en.wikipedia.org/wiki/International_Telecommunication_Union).

The main technological difference that distinguishes 3G technologies from 2G technology is the use of [packet switching](http://en.wikipedia.org/wiki/Packet_switching) rather than [circuit switching](http://en.wikipedia.org/wiki/Circuit_switching) for data transmission.

Compared to the older [2G](http://en.wikipedia.org/wiki/2G) and [2.5G](http://en.wikipedia.org/wiki/2.5G) standards, a 3G system must allow simultaneous use of speech and data services, and provide peak data rates of at least 200 [kbit/s](http://en.wikipedia.org/wiki/Kbps) according to the IMT-2000 specification.

In addition, the standardization process focused on requirements more than technology (2 Mbit/s maximum data rate indoors, 384 kbit/s outdoors, for example).

In 2001 the first commercial launch of [3G](http://en.wikipedia.org/wiki/3G) was in Japan by [NTT Do Como](http://en.wikipedia.org/wiki/NTT_DoCoMo) on the [WCDMA](http://en.wikipedia.org/wiki/WCDMA) standard.

In 2002 the first 3G networks on the rival CDMA2000 1xEV-DO technology were launched by SK Telecom and KTF in South Korea, and Monet in the USA.

The following standards are typically branded 3G:

* The [**UMTS**](http://en.wikipedia.org/wiki/UMTS) system, first offered in 2001, standardized by [3GPP](http://en.wikipedia.org/wiki/3GPP). The cell phones are typically UMTS and GSM hybrids. The original and most widespread radio interface is called [W-CDMA](http://en.wikipedia.org/wiki/W-CDMA). The latest release, [HSPA+](http://en.wikipedia.org/wiki/HSPA%2B), can provide peak data rates up to 56 Mbit/s in the downlink in theory (28 Mbit/s in existing services) and 22 Mbit/s in the uplink.
* The [**CDMA2000**](http://en.wikipedia.org/wiki/CDMA2000) system, first offered in 2002, standardized by [3GPP2](http://en.wikipedia.org/wiki/3GPP2), sharing infrastructure with the [IS-95](http://en.wikipedia.org/wiki/IS-95) 2G standard. The cell phones are typically CDMA2000 and IS-95 hybrids. The latest release [EVDO](http://en.wikipedia.org/wiki/EVDO) Rev B offers peak rates of 14.7 Mbit/s down streams.

UMTS

Universal Mobile Telecommunications System (UMTS) is one of the [third-generation](http://en.wikipedia.org/wiki/3G) (3G) [mobile telecommunications](http://en.wikipedia.org/wiki/Mobile_telecommunications) technologies.

The most common form of UMTS uses [W-CDMA](http://en.wikipedia.org/wiki/W-CDMA_%28UMTS%29) (IMT Direct Spread) as the underlying [air interface](http://en.wikipedia.org/wiki/Air_interface) but the system also covers [TD-CDMA](http://en.wikipedia.org/wiki/TD-CDMA) and [TD-SCDMA](http://en.wikipedia.org/wiki/TD-SCDMA) (both IMT CDMA TDD). UMTS requires new base stations and new frequency allocations. However, it is closely related to GSM/EDGE as it borrows and builds upon concepts from GSM.

The specific [frequency bands](http://en.wikipedia.org/wiki/Band_%28radio%29) originally defined by the UMTS standard are 1885–2025 MHz for the mobile-to-base (uplink) and 2110–2200 MHz for the base-to-mobile (downlink).

* WCDMA

W-CDMA (Wideband [Code Division Multiple Access](http://en.wikipedia.org/wiki/Code_Division_Multiple_Access)), UMTS-FDD, UTRA-FDD, or [IMT-2000](http://en.wikipedia.org/wiki/IMT-2000) CDMA Direct Spread is an [air interface](http://en.wikipedia.org/wiki/Air_interface) standard found in [3G](http://en.wikipedia.org/wiki/3rd_generation) [mobile telecommunications](http://en.wikipedia.org/wiki/Mobile_telecommunications) networks. It is sometimes used as a synonym for UMTS. It utilizes the [DS-CDMA](http://en.wikipedia.org/wiki/DS-CDMA) channel access method and the [FDD](http://en.wikipedia.org/wiki/Frequency-division_duplex) duplexing method to achieve higher speeds and support more users compared to most [time division multiple access](http://en.wikipedia.org/wiki/Time_division_multiple_access) (TDMA) schemes used today.

W-CDMA transmits on a pair of 5 MHz-wide radio channels. Though W-CDMA does use a [direct sequence](http://en.wikipedia.org/wiki/Direct-sequence_spread_spectrum) CDMA transmission technique like CDMA2000, W-CDMA is not simply a wideband version of CDMA2000.

CDMA 2000

CDMA2000 (also known as IMT Multicarrier (IMT‑MC)) is a family of [3G](http://en.wikipedia.org/wiki/3G) mobile technology standards, which use [CDMA](http://en.wikipedia.org/wiki/Code_division_multiple_access) [channel access](http://en.wikipedia.org/wiki/Channel_access_method), to send voice, data, and [signaling](http://en.wikipedia.org/wiki/Signaling_%28telecommunication%29) data between [mobile phones](http://en.wikipedia.org/wiki/Mobile_phone) and [cell sites](http://en.wikipedia.org/wiki/Cell_site). The set of standards includes: CDMA2000 1X, CDMA2000 EV-DO Rev. 0, CDMA2000 EV-DO Rev. A, and CDMA2000 EV-DO Rev. B

CDMA2000 transmits on one or several pairs of 1.25 MHz radio channels.

CDMA2000 1xEV-DO (Evolution-Data Optimized), often abbreviated as EV-DO or EV, is a [telecommunications](http://en.wikipedia.org/wiki/Telecommunication) standard for the [wireless](http://en.wikipedia.org/wiki/Wireless) transmission of data through [radio](http://en.wikipedia.org/wiki/Radio) signals, typically for [broadband Internet access](http://en.wikipedia.org/wiki/Broadband_Internet_access). It uses [multiplexing](http://en.wikipedia.org/wiki/Multiplexing) techniques including [code division multiple access](http://en.wikipedia.org/wiki/Code_division_multiple_access) (CDMA) as well as [time division multiple access](http://en.wikipedia.org/wiki/Time_division_multiple_access) (TDMA) to maximize both individual user's throughput and the overall system throughput.

The EV-DO feature of CDMA2000 networks provides access to mobile devices with [forward link](http://en.wikipedia.org/wiki/Forward_link) air interface speeds of up to 2.4 Mbit/s with Rev. 0 and up to 3.1 Mbit/s with Rev. A. The [reverse link](http://en.wikipedia.org/wiki/Reverse_link) rate for Rev. 0 can operate up to 153 kbit/s, while Rev. A can operate at up to 1.8 Mbit/s.

The high connection speeds of 3G technology enabled a transformation in the industry: for the first time, media streaming of radio (and even television) content to 3G handsets became possible. The bandwidth and location information available to 3G devices gives rise to applications not previously available to mobile phone users. Some of the applications are:

**Mobile TV** – a provider redirects a TV channel directly to the subscriber's phone where it can be watched.

**Video on demand** – a provider sends a movie to the subscriber's phone.

**Video conferencing** – subscribers can see as well as talk to each other.

**Tele-medicine** – a medical provider monitors or provides advice to the potentially isolated subscriber.

**Location-based services** – a provider sends localized weather or traffic conditions to the phone, or the phone allows the subscriber to find nearby businesses or friends.

3.5G

One of the newest 3G technologies to be implemented is [High-Speed Downlink Packet Access](http://en.wikipedia.org/wiki/High-Speed_Downlink_Packet_Access) (HSDPA). It is an enhanced [3G](http://en.wikipedia.org/wiki/3G) (third generation) [mobile telephony](http://en.wikipedia.org/wiki/Mobile_telephony) [communications protocol](http://en.wikipedia.org/wiki/Communications_protocol) in the [High-Speed Packet Access](http://en.wikipedia.org/wiki/High-Speed_Packet_Access) (HSPA) family, also coined 3.5G, 3G+ or turbo 3G, which allows networks based on [Universal Mobile Telecommunications System](http://en.wikipedia.org/wiki/Universal_Mobile_Telecommunications_System) (UMTS) to have higher data transfer speeds and capacity.

Current HSDPA deployments support down-link speeds of 1.8, 3.6, 7.2 and 14.0 [Mbit](http://en.wikipedia.org/wiki/Megabit)/s. HSPA+ provides [HSPA](http://en.wikipedia.org/wiki/High-Speed_Packet_Access) [data rates](http://en.wikipedia.org/wiki/Data_rate) up to 56 Mbit/s on the downlink and 22 Mbit/s on the uplink. Future revisions of HSPA+ support up to 168 Mbit/s using multiple carriers.

By the end of 2007 there were 295 Million subscribers on 3G networks worldwide, which reflected 9% of the total worldwide subscriber base. About two thirds of these were on the WCDMA standard and one third on the EV-DO standard.

GROWTH OF MOBILE BROADBAND AND THE EMERGENCE OF 4G

By 2009, it had become clear that, at some point, 3G networks would be overwhelmed by the growth of bandwidth-intensive applications like streaming media. Consequently, the industry began looking to data-optimized 4th-generation technologies, with the promise of speed improvements up to 10-fold over existing 3G technologies.

The first two commercially available technologies billed as 4G were the [WiMAX](http://en.wikipedia.org/wiki/WiMAX) standard (offered in the U.S. by [Sprint](http://en.wikipedia.org/wiki/Sprint)) and the [LTE](http://en.wikipedia.org/wiki/3GPP_Long_Term_Evolution) standard, first offered in Scandinavia by [TeliaSonera](http://en.wikipedia.org/wiki/TeliaSonera).

Although LTE is often marketed as 4G, first-release LTE is actually a 3.9G technology since it does not fully comply with the [IMT Advanced](http://en.wikipedia.org/wiki/IMT_Advanced) 4G requirements. The pre-4G standard is a step towards [LTE Advanced](http://en.wikipedia.org/wiki/LTE_Advanced), a 4th generation standard ([4G](http://en.wikipedia.org/wiki/4G)) of radio technologies designed to increase the capacity and speed of mobile telephone networks. The LTE specification provides downlink peak rates of at least 100 Mbit/s, an uplink of at least 50 Mbit/s. The main advantages with LTE are high throughput, low latency, plug and play, [FDD](http://en.wikipedia.org/wiki/Duplex_telecommunications#Frequency-Division_Duplexing) and [TDD](http://en.wikipedia.org/wiki/Time-division_duplex) in the same platform, an improved end-user experience and a simple architecture resulting in low operating costs.

WiMAX (Worldwide Interoperability for Microwave Access) is a [telecommunications](http://en.wikipedia.org/wiki/Telecommunication) protocol that provides fixed and fully mobile internet access. The current WiMAX revision provides up to 40 Mbit/s[[1]](file:///C:\\Documents%20and%20Settings\\Siva\\Desktop\\New%20Folder%20%284%29\\WiMAX.htm" \l "cite_note-0)[[2]](file:///C:\Documents%20and%20Settings\Siva\Desktop\New%20Folder%20%284%29\WiMAX.htm#cite_note-1) with the [IEEE 802.16m](http://en.wikipedia.org/wiki/IEEE_802.16m) update expected offer up to 1 Gbit/s fixed speeds.

One of the main ways in which 4G differed technologically from 3G was in its elimination of [circuit switching](http://en.wikipedia.org/wiki/Circuit_switching), instead employing an all-IP network. Thus, 4G ushered in a treatment of voice calls just like any other type of streaming audio media, utilizing packet switching over [internet](http://en.wikipedia.org/wiki/Internet), [LAN](http://en.wikipedia.org/wiki/LAN) or [WAN](http://en.wikipedia.org/wiki/WAN) networks via [VoIP](http://en.wikipedia.org/wiki/VoIP).

**GSM VS CDMA**

In cellular service there are two main competing network technologies: Global System for Mobile Communications ([GSM](http://www.wisegeek.com/what-is-gsm.htm)) and Code Division Multiple Access ([CDMA](http://www.wisegeek.com/what-is-cdma.htm)).

The main points of contention between GSM and CDMA are as below:-

1. Data Transfer Speed:

CDMA has been traditionally faster than GSM, though both technologies continue to rapidly leapfrog along this path. Both boast "3G" standards, or 3rd generation technologies.

2. Subscriber Identity Module (SIM) cards:

In most of the countries only GSM phones use SIM cards. The removable SIM card allows phones to be instantly activated, interchanged, swapped out and upgraded, all without carrier intervention. The SIM itself is tied to the network, rather than the actual phone. Phones that are card-enabled can be used with any GSM carrier.   
The CDMA equivalent, an R-UIM card, is only available in parts of Asia. CDMA carriers require proprietary handsets that are linked to one carrier only and are not card-enabled. To upgrade a CDMA phone, the carrier must deactivate the old phone then activate the new one. The old phone becomes useless.

3. Roaming:

GSM carriers, however, have roaming contracts with other GSM carriers, allowing wider coverage of more rural areas, generally speaking, often without roaming charges to the customer. CDMA networks may not cover rural areas as well as GSM carriers, and though they may contract with GSM cells for roaming in more rural areas, the charge to the customer will generally be significantly higher.

MORE ABOUT IS-95

Interim Standard 95 (IS-95) is the first [CDMA](http://en.wikipedia.org/wiki/CDMA)-based digital cellular standard by [Qualcomm](http://en.wikipedia.org/wiki/Qualcomm). The brand name for IS-95 is cdmaOne. IS-95 is also known as TIA-EIA-95.

It is a [2G](http://en.wikipedia.org/wiki/2G) [Mobile Telecommunications Standard](http://en.wikipedia.org/wiki/Mobile_Telecommunications_Standard) that uses [CDMA](http://en.wikipedia.org/wiki/CDMA), a [multiple access](http://en.wikipedia.org/wiki/Multiple_access) scheme for [digital radio](http://en.wikipedia.org/wiki/Digital_radio), to send voice, data and signaling data (such as a dialed telephone number) between mobile [telephones](http://en.wikipedia.org/wiki/Telephone) and [cell sites](http://en.wikipedia.org/wiki/Cellular_phone).

[CDMA](http://en.wikipedia.org/wiki/CDMA) or "code division multiple access" is a [digital radio](http://en.wikipedia.org/wiki/Digital_radio) system that transmits streams of [bits](http://en.wikipedia.org/wiki/Bit) ([PN codes](http://en.wikipedia.org/wiki/PN_code)). CDMA permits several radios to share the same frequencies. Unlike [TDMA](http://en.wikipedia.org/wiki/Time_division_multiple_access) "time division multiple access", a competing system used in [2G](http://en.wikipedia.org/wiki/2G) [GSM](http://en.wikipedia.org/wiki/GSM), all radios can be active all the time, because network capacity does not directly limit the number of active radios. Since larger numbers of phones can be served by smaller numbers of cell-sites, CDMA-based standards have a significant economic advantage over TDMA-based standards, or the oldest cellular standards that used [frequency-division multiplexing](http://en.wikipedia.org/wiki/FDMA).

MORE ABOUT GSM

GSM is a [cellular network](http://en.wikipedia.org/wiki/Cellular_network), which means that [mobile phones](http://en.wikipedia.org/wiki/Mobile_phone) connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—[macro](http://en.wikipedia.org/wiki/Macrocell), [micro](http://en.wikipedia.org/wiki/Microcell), [Pico](http://en.wikipedia.org/wiki/Picocell), [femto](http://en.wikipedia.org/wiki/Femtocell) and umbrella cells. The coverage area of each cell varies according to the implementation environment.

Macro cells can be regarded as cells where the [base station](http://en.wikipedia.org/wiki/Base_station) [antenna](http://en.wikipedia.org/wiki/Antenna_%28electronics%29) is installed on a mast or a building above average roof top level. Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas. Pico cells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors. Femto cells are cells designed for use in residential or small business environments and connect to the service provider’s network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells.

The [modulation](http://en.wikipedia.org/wiki/Modulation) used in GSM is [**Gaussian minimum-shift keying**](http://en.wikipedia.org/wiki/Gaussian_minimum-shift_keying) **(GMSK)**, a kind of continuous-phase [frequency shift keying](http://en.wikipedia.org/wiki/Frequency_shift_keying). In GMSK, the signal to be modulated onto the carrier is first smoothed with a [Gaussian](http://en.wikipedia.org/wiki/Gaussian_function) [low-pass filter](http://en.wikipedia.org/wiki/Low-pass_filter) prior to being fed to a [frequency modulator](http://en.wikipedia.org/wiki/Frequency_modulation), which greatly reduces the interference to neighboring channels ([adjacent-channel interference](http://en.wikipedia.org/wiki/Adjacent-channel_interference)).

GSM networks operate in a number of different carrier frequency ranges (separated into [GSM frequency ranges](http://en.wikipedia.org/wiki/GSM_frequency_ranges) for 2G and [UMTS frequency bands](http://en.wikipedia.org/wiki/UMTS_frequency_bands) for 3G), with most [2G](http://en.wikipedia.org/wiki/2G) GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead (for example in [Canada](http://en.wikipedia.org/wiki/Canada) and the [United States](http://en.wikipedia.org/wiki/United_States)).

Regardless of the frequency selected by an operator, it is divided into [timeslots](http://en.wikipedia.org/wiki/Time_division_multiplexing) for individual phones to use. This allows eight full-rate or sixteen half-rate speech channels per [radio frequency](http://en.wikipedia.org/wiki/Radio_frequency). These eight radio timeslots (or eight [burst](http://en.wikipedia.org/wiki/Burst_transmission) periods) are grouped into a [TDMA](http://en.wikipedia.org/wiki/Time_division_multiple_access) frame. Half rate channels use alternate frames in the same timeslot. The channel data rate for all 8 channels is 270.833 kbit/s, and the frame duration is 4.615 ms.

One of the key features of GSM is the [Subscriber Identity Module](http://en.wikipedia.org/wiki/Subscriber_Identity_Module), commonly known as a **SIM card**. The SIM is a detachable [smart card](http://en.wikipedia.org/wiki/Smart_card) containing the user's subscription information and phone book. This allows the user to retain his or her information after switching handsets. Alternatively, the user can also change operators while retaining the handset simply by changing the SIM.

A SIM card contains its unique serial number, internationally unique number of the mobile user ([IMSI](http://en.wikipedia.org/wiki/IMSI)), security authentication and ciphering information, temporary information related to the local network, a list of the services the user has access to and two passwords ([PIN](http://en.wikipedia.org/wiki/Personal_identification_number) for usual use and [PUK](http://en.wikipedia.org/wiki/Personal_Unblocking_Code) for unlocking).

SIM cards are available in three standard sizes. The first is the size of a [credit card](http://en.wikipedia.org/wiki/Credit_card) (85.60 mm × 53.98 mm x 0.76 mm). The newer, most popular miniature version has the same thickness but a length of 25 mm and a width of 15 mm, and has one of its corners truncated (chamfered) to prevent misinsertion. The newest incarnation known as the 3FF or micro-SIM has dimensions of 15 mm × 12 mm.

There are three operating voltages for SIM cards: 5 V, 3 V and 1.8 V.

SIM cards store network-specific information used to authenticate and identify subscribers on the network. The most important of these are the [ICC-ID](file:///C:\Documents%20and%20Settings\Siva\Desktop\siva\SIM_card.htm#Integrated_Circuit_Card_ID_.28ICC-ID.29), [IMSI](http://en.wikipedia.org/wiki/IMSI), Authentication Key (Ki), Local Area Identity (LAI) and Operator-Specific Emergency Number. The SIM also stores other carrier specific data such as the SMSC (Short Message Service Center) number, Service Provider Name (SPN), Service Dialing Numbers (SDN), Advice-Of-Charge parameters and Value Added Service (VAS) applications.

Integrated circuit card identifier (ICC-ID)

Each SIM is internationally identified by its ICC-ID. ICC-IDs are stored in the SIM cards and are also engraved or printed on the SIM card body during a process called personalization

INTERNATIONAL MOBILE SUBSCRIBER IDENTITY (IMSI)

SIM cards are identified on their individual operator networks by a unique [IMSI](http://en.wikipedia.org/wiki/IMSI). [Mobile operators](http://en.wikipedia.org/wiki/Mobile_operators) connect mobile phone calls and communicate with their market SIM cards using their IMSIs. The format is:

The first 3 digits represent the [Mobile Country Code (MCC)](http://en.wikipedia.org/wiki/Mobile_country_code).

The next 2 or 3 digits represent the [Mobile Network Code (MNC)](http://en.wikipedia.org/wiki/Mobile_network_code). 3 digit MNC codes are allowed by E.212 but are only implemented in some countries in North America, the Caribbean and Latin America. The next digits represent the mobile station identification number. Normally there will be 10 digits but would be fewer in the case of a 3 digit MNC or if national regulations indicate that the total length of the IMSI should be less than 15 digits.

Authentication process

When the Mobile Equipment starts up, it obtains the International Mobile Subscriber Identity (IMSI) from the SIM card, and passes this to the mobile operator requesting access and authentication. The Mobile Equipment may have to pass a PIN to the SIM card before the SIM card will reveal this information. The operator network searches its database for the incoming IMSI and its associated Ki. The operator network then generates a Random Number (RAND, which is a [nonce](http://en.wikipedia.org/wiki/Cryptographic_nonce)) and signs it with the Ki associated with the IMSI (and stored on the SIM card), computing another number known as Signed Response 1 (SRES\_1).

The operator network then sends the RAND to the Mobile Equipment, which passes it to the SIM card. The SIM card signs it with its Ki, producing SRES\_2 which it gives to the Mobile Equipment along with encryption key Kc. The Mobile Equipment passes SRES\_2 on to the operator network.

The operator network then compares its computed SRES\_1 with the computed SRES\_2 that the Mobile Equipment returned. If the two numbers match the SIM is authenticated and the Mobile Equipment is granted access to the operator's network. Kc is used to encrypt all further communications between the Mobile Equipment and the network.

INTERNATIONAL MOBILE EQUIPMENT IDENTITY

The International Mobile Equipment Identity or IMEI is a number, usually unique, to identify [GSM](http://en.wikipedia.org/wiki/GSM), [WCDMA](http://en.wikipedia.org/wiki/WCDMA), and [iDEN](http://en.wikipedia.org/wiki/IDEN) [mobile phones](http://en.wikipedia.org/wiki/Mobile_phone), as well as some [satellite phones](http://en.wikipedia.org/wiki/Satellite_phone). It is usually found printed inside the battery compartment of the phone. It can also be displayed on the screen of the phone by entering **\*#06#** into the keypad on most phones.

The IMEI number is used by the [GSM](http://en.wikipedia.org/wiki/GSM) network to identify valid devices and therefore can be used for stopping a stolen phone from accessing the network in that country. For example, if a [mobile phone](http://en.wikipedia.org/wiki/Mobile_phone) is stolen, the owner can call his or her network provider and instruct them to "ban" the phone using its IMEI number. This renders the phone useless in that country, whether or not the phone's [SIM](http://en.wikipedia.org/wiki/Subscriber_Identity_Module) is changed. However, the phone can be used abroad.

Unlike the [Electronic Serial Number](http://en.wikipedia.org/wiki/Electronic_Serial_Number) or [MEID](http://en.wikipedia.org/wiki/Mobile_Equipment_Identifier) of [CDMA](http://en.wikipedia.org/wiki/CDMA) and other wireless networks, the IMEI is only used for identifying the device, and has no permanent or semi-permanent relation to the subscriber.

BLACKLIST OF STOLEN DEVICES

When mobile equipment is stolen or lost the owner can typically contact their local operator with a request that it should be blocked. If the local operator possesses an Equipment Identity Register (EIR), it then will put the device IMEI into it, and can optionally communicate this to the [Central Equipment Identity Register](http://en.wikipedia.org/wiki/Central_Equipment_Identity_Register) (CEIR) which blacklists the device in all other operator switches that use the CEIR. With this blacklisting in place the device becomes unusable on any operator that uses the CEIR, making theft of mobile equipment a useless business proposition, unless for parts.

The IMEI number is not supposed to be easy to change, making the CEIR blacklisting effective. However this is not always the case: a phone's IMEI may be easy to change with special tools.

LIMITATIONS

"New IMEIs can be programmed into stolen handsets and 10% of IMEIs are not unique."

STRUCTURE OF THE IMEI AND IMEISV (IMEI SOFTWARE VERSION)

The IMEI (14 decimal digits plus a check digit) or IMEISV (16 digits) includes information on the origin, model, and serial number of the device. The model and origin comprise the initial 8-digit portion of the IMEI/SV, known as the [Type Allocation Code](http://en.wikipedia.org/wiki/Type_Allocation_Code) (TAC).

COMPARISON TO SIMILAR SYSTEMS

[Car phone](http://en.wikipedia.org/wiki/Car_phone)

A type of telephone permanently mounted in a [vehicle](http://en.wikipedia.org/wiki/Vehicle), these often have more powerful transmitters, an external antenna and loudspeaker for hands free use. They usually connect to the same networks as regular mobile phones.

[Cordless telephone](http://en.wikipedia.org/wiki/Cordless_telephone) (portable phone)

Cordless phones are telephones which use one or more radio handsets in place of a wired handset. The handsets connect wirelessly to a base station, which in turn connects to a conventional [land line](http://en.wikipedia.org/wiki/Land_line) for calling. Unlike mobile phones, cordless phones use private base stations (belonging to the land-line subscriber), which are not shared.

[Professional Mobile Radio](http://en.wikipedia.org/wiki/Professional_Mobile_Radio)

Advanced professional mobile radio systems can be very similar to mobile phone systems. Notably, the [IDEN](http://en.wikipedia.org/wiki/IDEN) standard has been used as both a private [trunked radio system](http://en.wikipedia.org/wiki/Trunked_radio_system) as well as the technology for several large public providers. Similar attempts have even been made to use [TETRA](http://en.wikipedia.org/wiki/TETRA), the European digital PMR standard, to implement public mobile networks.

[Radio phone](http://en.wikipedia.org/wiki/Radiotelephone)

This is a term which covers radios which could connect into the telephone network. These phones may not be mobile; for example, they may require a [mains](http://en.wikipedia.org/wiki/Mains_electricity) power supply, or they may require the assistance of a human operator to set up a [PSTN](http://en.wikipedia.org/wiki/PSTN) phone call.

[Satellite phone](http://en.wikipedia.org/wiki/Satellite_phone)

This type of phone communicates directly with an [artificial satellite](http://en.wikipedia.org/wiki/Artificial_satellite), which in turn relays calls to a base station or another satellite phone. A single satellite can provide coverage to a much greater area than terrestrial base stations. Since satellite phones are costly, their use is typically limited to people in remote areas where no mobile phone coverage exists, such as mountain climbers, mariners in the open sea, and news reporters at disaster sites.

[IP Phone](http://en.wikipedia.org/wiki/IP_Phone)

This type of phone delivers or receives calls over [internet](http://en.wikipedia.org/wiki/Internet), [LAN](http://en.wikipedia.org/wiki/LAN) or [WAN](http://en.wikipedia.org/wiki/WAN) networks using [VoIP](http://en.wikipedia.org/wiki/VoIP) as opposed to traditional [CDMA](http://en.wikipedia.org/wiki/CDMA) and [GSM](http://en.wikipedia.org/wiki/GSM) networks. In business, the majority of these IP Phones tend to be connected via wired [Ethernet](http://en.wikipedia.org/wiki/Ethernet), however wireless varieties do exist. Several vendors have developed standalone Wi-Fi phones. Additionally, some cellular mobile phones include the ability to place VoIP calls over cellular high speed data networks and/or wireless internet.

**LOST MOBILE DETECTION: SNIFFER DEVICE**

The mobile cellular communication has been appreciated since its birth in the early 70’s and the advancement in the field of VLSI has helped in designing less power, smaller size but efficient transceiver for the purpose of communication. But however the technology has not yet answered the loss or misplacement of the lost mobile phone which is significantly increasing.

DESIGNING OF THE SNIFFER

The device can be called as a mobile base station that includes the following important components:

1) Sniffer base station

2) Unidirectional antenna

3) Tracking software

SNIFFER BASE STATION:

The sniffer is a small base station, it includes transceiver section. It should operate at a frequency that is much different from the frequency of the current cell in which the operation of detection is being carried out.

Some of the main important things are the frequency that has to be generated by the transceiver section is around 900MHz range which is a VHF range and it is necessary to design the oscillator circuit for that frequency range. Another important thing is the cooling that has to be provided to the circuit that is to be operated at 900MHz range of frequency. Hence proper design of base station is an important thing in the design of the sniffer.

DESIGN OF UNIDIRECTIONAL ANTENNA:

The directional antenna acts as the eyes for the sniffer for the purpose of the detecting the lost mobile phones.

The factors that are to be taken into account during the development of the antenna for the sniffer should be the gain and the directivity.

Since the sniffer device that is constructed is a device that has both the transmitting and the receiving antenna effective gain has to be taken into account and this shows the ability of the antenna to capture the signal that the lost mobile is transmitting.

SOFTWARE FOR THE TRACKING:

The main feature of this software is that it helps in the process of creation of the data base and this is mainly done using a Random Access Memory. The RAM of the sniffer device stores the IMEI number of the lost mobile phone.

The software that is to be designed in such a way that the software has the input as the IMEI number of the lost mobile phone from the RAM and this is done using the SQL query that fetches the IMEI number. After getting the input of the lost mobile phones IMEI number it checks the comport for getting the information whether it obtains any signaling information from the lost device that might respond to the signal sent by the sniffer.

WORKING OF THE SNIFFER DEVICE

The fig 2 &3 shows the working of the sniffer; fig2 gives the normal operation of the mobile with the base station and there is a BTS that acts as a middle man in the process of communication between the mobile and the MTSO which is popularly known as MSC or Mobile Switching Centre. There is always a two way communication between devices and before the establishment of the communication the authentication of the SIM card that has the IMSI or the International Mobile Subscriber Identifier is done. This IMSI number helps in the authorization of the user. The second authentication is the authentication of the handset, which is done in EIR or the Equipment Identifier Register. This register is located at the MSC and it contains the IMEI number of the lost handset and if the signal is obtained from the normal one then the two way communication is established.

The IMEI of the lost mobile phone number once has been reported to the service provider, who keeps in track of the record of lost mobile phones. The MTSO or the MSC which keeps in track of all the mobile phones with IMEI number and the IMSI number has the information of the lost mobile phones location which means the location of the cell where the lost device is because of the two way communication with the device the BTS of the lost device is known to MSC. From this information regarding the cell in which the device is located the sniffer device is introduced.

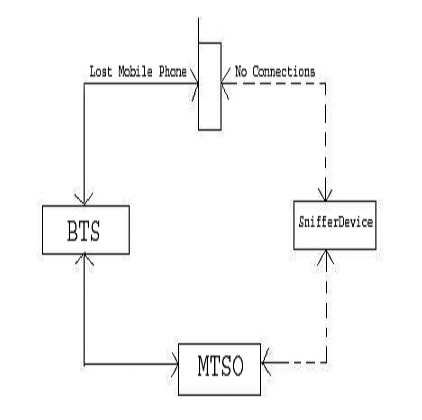


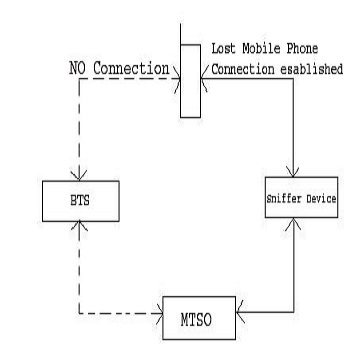
Fig 2 .The initial connection between the cellular network and lost mobile phone

The next figure or the fig 3 shows the sniffer that gets into work for the purpose of detection of the lost device. After the information regarding the IMEI number of the lost device is provided by the MTSO or MSC .This is then fed into the sniffers main memory. The sniffer located in particular cell gets into action of detecting the lost device. The base station disconnects the connection with the lost mobile phone, as there is a request regarding this action from the EIR part of the MSC. This causes the lost device to search the BTS to get locked with since each base station does not have authorization capability the lost device send appropriate connection request signal. Now when the sniffer device is being deployed and this device has in built authorization capability the lost device finds the sniffer to get itself locked to the frequency of the sniffer. While the connection between the sniffer and the mobile phone is established; the IMEI of the lost mobile is validated with the stored IMEI and after successful authorization the communication between the sniffer and the lost device is established. If the other devices in the same try to communicate with the sniffer the access is denied and this is done at the validation done based on the IMEI. Once the communication starts it is mainly with the antenna and the signal strength of the lost device the location can be tracked. However the process of searching can also be aided with the GPS system for more accurate and fast detection.

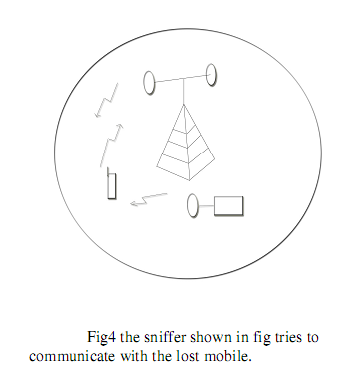
The sniffer uses a frequency that is different from the one that is being used by the base station and the located nearby cells.

Hence the interference from the nearby cell can be avoided. The directional antenna is used in finding the location of the mobile phone.

Here the signal strength of the received signal antenna pattern is plotted once the signal of the mobile is obtained. The no. of antenna pattern for different position of same mobile phone is used to find the exact location. But however in this method the directional antenna used much be of a very small beam width this helps in more accurate process of detection.



Sniffer for the detection of lost Mobile phones” paves a way by means of which the lost mobile phones can be recovered. But the process of detection is yet to be developed thoroughly. There are certain boundary conditions or criteria that have to be qualified for the identification of the lost mobile like the power of the mobile should be good enough , the mobile phone should not be in the shadow region etc., but however this method can be improved by using modern technologies and devices.



**HAZARDS OF MOBILE PHONES**

One of the most common sights we see these days is that of people with their mobile phones next to their ears. A boon for better communication, cell phone usage nonetheless has health hazards.

Mobile phone radiation and health concerns have been raised, especially following the enormous increase in the use of [wireless mobile telephony](http://en.wikipedia.org/wiki/Mobile_phone) throughout the world(as of June 2009[[update]](http://en.wikipedia.org/w/index.php?title=Mobile_phone_radiation_and_health&action=edit), there were more than 4.3 billion users worldwide).

[Mobile phones](http://en.wikipedia.org/wiki/Mobile_phone) use [electromagnetic radiation](http://en.wikipedia.org/wiki/Electromagnetic_radiation) in the [microwave](http://en.wikipedia.org/wiki/Microwave) range, and some believe this may be harmful to human health. These concerns have induced a large body of research (both [epidemiological](http://en.wikipedia.org/wiki/Epidemiology) and experimental, in [non-human animals](http://en.wikipedia.org/wiki/Animal_model) as well as in humans). The microwave radiation from mobile phones has harmful effects at intensity levels far below the official safety threshold values. This is confirmed by a considerable body of evidence.

Concerns about effects on health have also been raised regarding other [digital wireless systems](http://en.wikipedia.org/wiki/Wireless_electronic_devices_and_health), such as data communication networks.

Various studies were conducted throughout the world to determine the affect of cell phone radiation on human health. Some studies indicate that the emissions from a cell phone can be extremely harmful, causing genetic damage, tumors, memory loss, and increased blood pressure and weakening of the immune system while some observe that there is no evidence of causing any harmful effects.

The hazards from the radiations can be classified into the following types:

[1. Health hazards of handsets](file:///D:\siva%27s\Mobile_phone_radiation_and_health.htm#Health_hazards_of_handsets)

[1.1 Thermal effects](file:///D:\siva%27s\Mobile_phone_radiation_and_health.htm#Thermal_effects)

[1.2 Non-thermal effects](file:///D:\siva%27s\Mobile_phone_radiation_and_health.htm#Non-thermal_effects)

[1.3 Genotoxic effects](file:///D:\siva%27s\Mobile_phone_radiation_and_health.htm#Genotoxic_effects)

[1.4 Mobile phones and cancer](file:///D:\siva%27s\Mobile_phone_radiation_and_health.htm#Mobile_phones_and_cancer)

[2. Health hazards of base stations](file:///D:\siva%27s\Mobile_phone_radiation_and_health.htm#Health_hazards_of_base_stations)

The current international standards (based on ICNIRP recommendations) are purely based on the thermal effects of radiation where as various epidemiological and experimental studies have shown to have significant biological effects far below these standards.

THERMAL EFFECTS

When a human body is exposed to the electromagnetic radiation, it absorbs radiation, because human body contains 70% of liquid. It is similar to that of cooking in the microwave oven. The human height is much greater than the wavelength of the cell tower transmitting frequencies, so there will be multiple resonances in the body, which creates localized heating inside the body. These result in boils, drying up the fluids around eyes, brain, joints, heart, abdomen, etc .In the case of a person using a cell phone, most of the heating effect will occur at the surface of the head, causing its [temperature](http://en.wikipedia.org/wiki/Temperature) to increase by a fraction of a degree. It has been claimed that some parts of the human head are more sensitive to damage from increases in temperature, particularly in anatomical structures with poor vasculature, such as [nerve](http://en.wikipedia.org/wiki/Nerve) fibers. The brain's [blood circulation](http://en.wikipedia.org/wiki/Blood_circulation) is capable of disposing of excess heat by increasing local [blood flow](http://en.wikipedia.org/wiki/Blood_flow). However, the [cornea](http://en.wikipedia.org/wiki/Cornea) of the eye does not have this [temperature regulation](http://en.wikipedia.org/wiki/Temperature_regulation) mechanism. Hence they get affected.

According to the report published in “THE HINDU”, mobile phones and radio terminals radiate RF energy that heat up the tissues. During use, mobile phones are usually kept close to the ear, which is very near to the brain. It is suspected that continuous use of mobile phone for longer duration may damage some brain tissues.

NON-THERMAL EFFECTS

Non-thermal effects of Radio frequency radiation accumulate over time and the risks are more pronounced after 8 to 10 years of exposure. The effects are not observed in the initial years of exposure as the body has certain defense mechanisms and the pressure is on the stress proteins of the body, namely the heat shock proteins. This means that the body recognizes these electromagnetic radiations as a potential harm. An additional concern is that if the stress goes on too long, there is a reduced response, and the cells are less protected against the damage. This is why prolonged or chronic exposures may be quite harmful, even at very low intensities.

A new study suggests that long-term use of a cell phone may damage a person’s inner ear and high frequency hearing ability. People who had used cellular phones for over a year suffered increases in the degree of hearing loss over the span of 12 months. The researchers have also found that people who used their phones for more than 60 minutes a day had a worse hearing. Threshold high frequency hearing loss is characterized by the loss of ability to hear consonants such as ‘s’, ‘f’, ‘t’, and ‘z’, even though vowels can be heard normally. As a result of high frequency hearing loss, people hear sounds but fail to make out what is being said.

Cell phone radiation has been shown to cause the blood-brain barrier to leak. It is about a problem with known and unknown consequences from Blood-Brain Barrier (BBB) leakage resulting from cell phone use, including the possibility of brain tumors. The BBB protects the brain from many molecules that are toxic to the brain (e.g., albumin).

Professor Leif Salford, of the Department of Neurosurgery, from Lund University in Sweden has shown cell phone radiation results in leakage of the BBB. The highest BBB leakage occurs at lower exposure levels and decreases for higher exposure levels.

Scientists from the *Radiation and Nuclear Safety Authority* found that exposing human cells to mobile phone radiation damaged the blood-brain barrier - a safety barrier in the body that stops harmful substances in blood from entering the brain. They discovered that the exposure caused the cells in blood vessel walls to shrink which enabled molecules to pass into brain tissue.

GENOTOXIC EFFECTS

Studies by Carl Blackman have shown that weak electromagnetic fields release calcium ions from cell membranes. Leakage of calcium ions into the cytosol acts as a metabolic stimulant, which accelerates growth and healing, but it also promotes the growth of tumors. Loss of calcium ions causes leaks in the membranes of lysosomes releasing DNAase that causes DNA damage. Another possibility of DNA damage is via increased free radical formation inside cells [5, 6], which further causes cellular damage in the mitochondria.

In 1995, in the journal *Bioelectromagnetics*, Wengong Lai and Mohinder Singh reported damaged DNA after two hours of microwave radiation at levels deemed safe according to government standards. Later, in December 2004, a pan-[European](http://en.wikipedia.org/wiki/Europe) study named REFLEX (Risk Evaluation of Potential Environmental Hazards from Low Energy Electromagnetic Field (EMF) Exposure Using Sensitive in vitro Methods), involving 12 collaborating laboratories in several countries showed some compelling evidence of DNA damage of cells in in-vitro cultures, when exposed between 0.3 to 2 watts/kg, whole-sample average.

MOBILE PHONES AND CANCER

Independent research shows there is risk of brain tumors from cell phone use.

Studies led by Professor Lennart Hardell7 in Sweden found significantly increased risk of brain tumors from 10 or more years of cell phone or cordless phone use. Among their many significant findings are the following:

 for every 100 hours of cell phone use, the risk of brain cancer increases by 5%;

 for every year of cell phone use, the risk of brain cancer increases by 8%;

 after 10 or more years of digital cell phone use, there was a 280% increased risk of brain cancer;

 for digital cell phone users who were teenagers or younger when they first starting using a cell phone, there was a 420% increased risk of brain cancer.

Dr. George Carlo, leader of the Cellular Telecommunications Industry Association’s (CTIA) found cell phone use was causing brain tumors. Among the findings Dr. Carlo presented were:

 a statistically significant dose-response4 risk of acoustic neuroma with more than 6 years of cell phone use, and;

 Findings of genetic damage in human blood when exposed to cell phone radiation.

The study, conducted by Professor Lennart Hardell of the University Hospital in Orebro and Professor Kjell Hansson Mild of Umea University, found that long-term mobile users had double the chance of getting a tumor on the side of the brain where they held the handset.

HEALTH HAZARDS OF BASE STATIONS

An article from the news paper “THE HINDU” reports that:

Electromagnetic radiation from base station antennas of mobile networks and mobiles phones could pose serious health hazards to people, particularly children below 16 years, pregnant women and those using medical aids, according to a draft guidelines report issued by the Telecommunication Engineering Centre that comes under the Department of Telecommunications.

Seeking strict regulations for installing antennas to protect people from radiation, the report says that continuous use of mobile phone for longer duration may damage some brain tissues. Using hands-free facility seems to be a better option, if longer use is unavoidable.

The radio frequency electromagnetic field generated around the base station antenna may be harmful to general public and operator or maintenance personnel. The practice of installing antennas needs to be regulated in order to protect the general public from undesired effects caused by electromagnetic fields around the antenna, it says.

**A** German study found a threefold higher frequency of cancer among people living in the vicinity (400 m) of a GSM base station compared to people living further away from the antenna. Another area of worry about effects on the population's health have been the radiation emitted by [base stations](http://en.wikipedia.org/wiki/Cell_site) (the antennas on the surface which communicate with the phones), because, in contrast to mobile handsets, it is emitted continuously and is more powerful.

A study in Australia found that children living near TV and FM broadcast towers had more than twice the rate of leukemia as children living more than seven miles away from these towers .

EFFECT OF RADIATION ON CHILDREN

The report by “THE HINDU” says the tissues of children are tender, and therefore they are likely to be more affected by use of mobile phones. Children below 16 years should be discouraged from using mobile phones.

Children are more vulnerable to radio frequency radiation emissions as their skulls are thinner, their nervous system still developing and myelin sheath is yet not developed.

EFFECT ON ENVIRONMENT

• **Effect on farm animals**- According to Dr. W.Löscher of the Institute of Pharmacology, Toxicology and Pharmacy, Germany, Dairy cows that were kept in close proximity to a TV and cell phone Tower for two years had a reduction in milk production along with increased health problems and behavioral abnormalities.

•**Vanishing Bees**- A study in England showed that bees refused to return to their beehives where there was a DECT cordless phone station. It is discussed that the extensive use of mobile phones may be one reason why bee colonies are vanishing at a huge scale. Similarly, EMR from cell phone towers - diseases in plants & animals and is the reason for the vanishing butterflies, some insects and birds like sparrows.

OTHER EFFECTS

Similarly, the use of mobile phones or radio terminals by persons, using medical aids such as pace makers, defibrillators, hearing aids cochlear implants and other implants should be minimized, while the use of mobile phones or radio terminals in vulnerable areas of hospitals such as intensive care units, should be prohibited or restricted as decided by the hospital authorities.

In order to insure “safe” operation, many cell phone User Manuals state that the phone must be kept a certain distance from the user’s body to insure “safe” operation. For example, the Apple iPhone warns the user, “Tested for use at the ear and for body worn operation (with iPhone positioned 15 mm (5/8 inch) from the body).” This means that even the existing exposure limits (based on a false premise), will be violated if the cell phone is less than 15 mm from the body (e.g., held to the ear, in a shirt pocket, in a pants/trousers pocket, etc.).

Seeing the reports from individual researches stating that the cell phone radiations cause health hazards, to determine up to what extent they are correct, governments of many countries formed committees to investigate on this topic. Some of them are:

The multi-million dollar, 13-country Interphone study was implemented to determine whether there is a risk from cell phone use and 3 types of brain tumors: glioma (brain cancer in the brain’s glial cells), acoustic neuroma (a tumor of the auditory nerve in the brain), and meningioma (a tumor of the meninges - the lining of the brain and spinal cord). The Interphone study included the risk of other tumors (e.g., salivary gland) but the results of these studies are outside the scope of this document.

The 13 nation INTERPHONE project - the largest study of its kind ever undertaken - has now been published and did not find a solid link with mobile phones and brain tumors.

However, observations at the highest level of cumulative call time and the changing patterns of mobile phone use since the period studied by Interphone, particularly in young people, mean that further investigation of mobile phone use and brain cancer risk is merited.

A recent assessment was published in 2007 by the [European Commission](http://en.wikipedia.org/wiki/European_Commission) [Scientific Committee on Emerging and Newly Identified Health Risks](http://en.wikipedia.org/wiki/Scientific_Committee_on_Emerging_and_Newly_Identified_Health_Risks) (SCENIHR). It concludes that the three lines of evidence, *viz.* animal, *in vitro*, and epidemiological studies, indicate that "exposure to RF fields is unlikely to lead to an increase in cancer in humans."

**S**tudies have only muddled the issue. As with most controversial topics, different studies have different results. Some say that cell phones are linked to higher occurrences of cancer and other ailments, while other studies report that cell-phone users have no higher rate of cancer than the population as a whole. No study to date has provided conclusive evidence that cell phones can cause any of these illnesses. However, there are ongoing studies that are examining the issue more closely.

So, in this dilemma, as a common man we cannot totally rule out the risk from the cell phone radiation on health and also at the same time need not believe it to be too dangerous.

In this context, “**WHO**”-***world health organization***-, an apex body that is concerned about the health of people has suggested some tips to protect ourselves from the radiations. They are:

1) Mobile phone users should limit their exposure to harmful radio frequencies by cutting the length of calls.

2) Hands-free devices cut exposure by keeping the instrument away from the head and body.

3) Driving cum mobile phone talking should be banned.

4) Mobile phones should not be used in Intensive Care Units of hospitals as they can pose a danger to patients by interfering with the working of pacemakers and defibrillators.

5) People with hearing aids should not use mobile phones.

6) Base stations, which have low powered antennae on their terrace to communicate with cell phones, should not be located near children's schools and playground

PRECAUTIONS

Here are some simple steps you can take to substantially reduce your or your child’s, exposure to cell phone radiation:

1. When on a call, use a wired headset (not a wireless headset such as a Bluetooth), or use in speaker-phone mode, or send text messages.

2. Keep the cell phone away from your body (particularly pant/trouser or shirt pockets) or use a belt holster designed to shield the body from cell phone radiation, when not in use (stand-by mode).

3. Avoid use in a moving car, train, bus, or in rural areas at some distance from a cell tower (AKA mast or base station) as any of these uses will increase the power of the cell phone’s radiation.

4. Use the cell phone like an answering machine. Keep it off until you want to see who has called. Then return calls, if necessary, using steps 5 and 1.

5. Use a corded land-line phone, whenever possible, instead of a wireless phone.

6. Avoid use inside of buildings, particularly with steel structures.

7. Do not allow your children to sleep with a cell phone beneath their pillow or at the bedside.

8. Don’t use a cell phone if the signal is weak. The phone shoots out more radiation to compensate for a poor signal.

RECOMMENDATIONS

I call on our respective governments to give the highest priority to this list of actions:

 Ban marketing campaigns of cell phones designed solely for children.

 require proof of liability insurance coverage for potential health risks associated with cell phones and similar wireless devices prior to their being offered for sale.

 Review the scientific basis and adequacy of the EMF exposure limits.

 Allocate research funding, independent of industry funds and influence, to evaluate long-term adverse effects from cell phones and other harmful effects from different sources of EMF, particularly where children are concerned.

 Finance a wide-ranging awareness campaign aimed at young people to minimize their exposures to cell phone radiation in line with WHO recommendations.

 Require warning labels on all wireless devices.

 Make available maps showing exposure to high-voltage power lines, radio frequency and microwaves from telecommunication masts (cell towers), radio repeaters and telephone antennas.

 Publish a yearly report on the level of electromagnetic radiation in our respective nations.

EDUCATE THE CONSUMER

To educate a consumer about radiation from a mobile handset, the specific absorption rate value for each hand set should be provided by the manufacturers on the website as well as in the user’s manual, as per the International Commission on Non-Ionizing Radiation Protection guidelines. As a precautionary measure, the mobile phone service providers or manufacturers should avoid promotional advertisements showing vulnerable segments such as children or pregnant women using mobile phones.

SPECIFIC ABSORPTION RATE

Specific absorption rate (SAR) is a measure of the rate at which [energy](http://en.wikipedia.org/wiki/Energy) is [absorbed](http://en.wikipedia.org/wiki/Absorption) by the body when exposed to a [radio frequency](http://en.wikipedia.org/wiki/Radio_frequency) (RF) [electromagnetic field](http://en.wikipedia.org/wiki/Electromagnetic_field). It is defined as the [power](http://en.wikipedia.org/wiki/Power_%28physics%29) absorbed per [mass](http://en.wikipedia.org/wiki/Mass) of [tissue](http://en.wikipedia.org/wiki/Body_tissue) and has units of [watts](http://en.wikipedia.org/wiki/Watt) per [kilogram](http://en.wikipedia.org/wiki/Kilogram) (W/kg).[[1]](file:///C:\Documents%20and%20Settings\Siva\Desktop\siva\Specific_absorption_rate.htm#cite_note-0) SAR is usually averaged either over the whole body, or over a small sample volume (typically 1 g or 10 g of tissue). The value cited is then the maximum level measured in the body part studied over the stated volume or mass.

CONCLUSION

Many governmental bodies also require that competing telecommunication companies try to achieve sharing of towers so as to decrease environmental and cosmetic impact. This issue is an influential factor of rejection of installation of new antennas and towers in communities.

We are exposed to radiation from cell towers, radiation from cell phones, wireless phones, computers, laptops, TV towers, FM towers, microwave ovens, etc. All these radiations, which are additive in nature. Stricter radiation norms must be enforced by the policy makers across the globe. The solution to avoid excess radiation is to use radiation shield, which absorbs 10% to 50% of radiation depending upon its placement and direction of source of radiation. Multiple units can absorb radiation up to 80% to 90%.

Presently 2G is used and 3G is recently implemented in India. Some countries are using 3G and are recently implementing 4G.what I feel is that before implementing 3G extensively in our country we have to overcome the hazards, some of them described above, being faced using 2G. For instance, in India there are at least 10 service providers and hence resulting in high radiation. If we take the countries like U.K, Germany-already implementing 4G- we find that the number of operators are 4, 3 respectively. The govt.’s there have succeeded in limiting the radiation by limiting the number of service providers. So first we have to overcome the hazards being faced using 2G-if not fully at least up to some extent and then go forward with latest technologies.

“In this age, it is very difficult not to have technology. But with technology, come certain hazards. The only way to beat these is again, better technology. Electromagnetic radiation is everywhere. More and more wireless communication services (wimax, wireless Internet) have been developed expected and so is the artificial electromagnetic radiation. It seems that there is no way to reverse this trend. Scientists and engineers are developing better and safer wireless systems and devices. Smaller cell size, better base station antennas and other more advanced technologies will allow future cell phones to radiate much lower power. So one can only hope that cell phone hazards will be reduced.”

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