

The frequency spectrum allocated by malaysian communication computer science

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International Mobile Telecommunications-2000 (IMT-2000), also known as 3G or 3rd Generation, is the generation standard for mobile phones and telecommunication services. This generation is to meet specifications by the International Telecommunication Union. Various applications exist, including wide-area wireless voice phone, video calls, mobile, mobile TV Internet access and others.

The details spectrum for IMT-2000 shows like below: International Mobile Telecommunications-2000 (IMT2000)Frequency Division Duplex (FDD)

Upper band: 2110 to 2200 MHz

Lower band: 1920 to 2010 MHz

Time Division Duplex (TDD)

Frequency: 1915 to 1920MHz

Frequency: 2010 to 2025MHz

Figure 1. 1: Frequency spectrum IMT-2000.[2]

Global system for mobile communications (GSM) is a second generation cellular telecommunications system was first designed in the 1980 [12]. Compared with the first generation, GSM is more advanced enhancements such as in security, quality, capacity, and the ability to support integrated services. For examples GSM services is GSM-900 and GSM-1800 in which used in the world like Europe, the Middle East, parts of Asia and others country.

The details spectrum for GSM900 and GSM1800 shows like below; Global System for Mobile (GSM) in the 900 MHz Band

Upper band: 925 to 960 MHz

Lower band: 880 to 915 MHz

Global System for Mobile System in the 1800 MHz Band

Upper band: 1805 to 1880 MHz

Lower band: 1710 to 1785 MHz

Figure 1. 2: Frequency spectrum GSM900.[2] Figure 1. 3: Frequency spectrum GSM1800.[2] Summary for Service Operators [Maxis, Celcom, Digi and U-Mobile]; ServiceOperatorSystem StandardFrequency Spectrum (MHz)Access CodeCommercial NameService OfferedLower BandUpper Band

Maxis Mobile Sdn Bhd

GSM 900

GSM 1800

IMT-2000:

FDD

TDD

880-886,

905-915

1710-1735

1935-1950

2015-2020

925-93,

950-960

1805-1830

2125-2140

-

012

017

Maxis

Voice call, SMS, MMS, data plans & service, International roaming, WAP

Celcom (Malaysia) Berhad

GSM 900

GSM 1800

IMT-2000:

FDD

TDD

888-905

1735-1760

1950-1965

2020-2025

933-950

1830-1855

2140-2155

-

013

019

Celcom

Voice call, SMS, MMS, data plans & service, International roaming, WAP

Digi Telecommunication

Sdn Bhd

GSM 900

GSM 1800

IMT-2000:

FDD

TDD

886-888

1760-1785

1965-1980

2010-2015

931-933

1855-1880

2155-2170

-

010

016

Digi

Voice call, SMS, MMS, data plans & service, International roaming, WAP

U-Mobile Sdn Bhd

IMT-2000:

FDD

TDD

1920-1935

1915-1920

2110-2125

-

018

U-mobile

Voice call, SMS, MMS, WAP

Question 2The Fourth Generation (4G) technology candidates is foreseen most likely to be between Long Term Evolution Advanced (LTE-Advanced) proposed by the Third Generation Partnership Project (3GPP) and Mobile WiMAX using 802. 16m standardised by the Institute of Electrical and Electronics Engineers (IEEE). Distinguish the technical differences between these two technologies and give your opinion on the scenario and deployment of 4G in the near future. Long Term Evolution Advanced (LTE-Advanced) proposed by the Third Generation Partnership Project (3GPP)

3GPP Long Term Evolution (LTE) is new standard in networking technology tree move what was once realize GSM/EDGE and UMTS/HSxPA networking
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technologies. It is a project Generation Partnership Project third (3GPP), administered under one name trademark by one of associations in partnership, European Telecommunications Standards Institute.

LTE Evolution

Figure 2. 1: Mobile Technologies Charging

The first generation of cellular systems were based on analog standards and are introduced in 80s middle. This with quick to bring to one second generation digital's cellular standard that made use of digital modulation and signal processing. The second generation also led to a technology fragmentation. Once many standard contests exist, however what remains now are two main branches: referred to as GSM and CDMA branches or alternately referred as the 3GPP and 3GPP2 branches. These branches remained separate as they migrated to 3G systems focusing on more efficient voice transport as well providing data-services. LTE originated in the 3GPP standards organization, and a competing specification (EV-DO Rev C) started in the 3GPP2 body as the next evolutionary step. However, the support for EV-DO Rev C has waned and it has now become clear that the 3GPP2 radio interface evolution has effectively ceased, allowing a single cellular technology.

Figure 2. 2: LTE provides a smooth evolutionary path for operators deploying all 3GPP and non-3GPP technologies.

Technology Summary of LTE

FDMA on uplink

Scale able OFDM on downlink, Single Carrier

Variable Spectrum Width from 3 to 20 MHz

Up to 64 QAM, MIMO, Spatial Multiplexing(SM),

LTE- Advanced

Will be an evolution of LTE. Therefore LTE-Advanced must be backward compatible with LTE Release 8.

Requirements will meet or even exceed IMT-Advanced requirements following the ITU-R agenda.

Should support significantly increased instantaneous peak data rates in order to reach ITU requirements. Primary focus should be on low mobility users. It is required a further improvement of cell edge data rates.

Mobile WiMAX using 802. 16m standardised by the Institute of Electrical and Electronics Engineers (IEEE)

IEEE 802. 16 is a series of Wireless Broadband standards authored by the IEEE. The current version is IEEE 802. 16-2009 amended by IEEE 802. 16j-2009. IEEE 802. 16 is written by a working group established by IEEE Standards Board in 1999 to develop standards for the global deployment of broadband Wireless Metropolitan Area Networks. The Workgroup is a unit of the IEEE 802 LAN/MAN Standards Committee [3].

WiMAX Evolution

WiMAX grow almost independently (and in parallel) for cellular standard mentioned earlier. In late 90s, IEEE started a workgroup create one air interface to show multipoint wireless standard broadband. Working group lever DOCSIS (data on interface specification cable service) standard heavily especially in definition MAC's layers. Original standard modified into 802. 16d in 2004 introduce OFDM as transmission scheme. This standard intended at fixed applications and is sometimes referred to as fixed WiMAX. In 2005, 802. 16d further improving to for support for mobility and provide OFDM delivery system scalable. This standard known as 802. 16e/ mobile WiMAX. (It should be noted that products based on 802. 16d and 802. 16e inhering market and both classified as WiMAX's products lead to a few ambiguity on specific standard which is supported-802. 16d or 802. 16e.) Hope, 802. 16e standard expanding to 802. 16m which focusing on addition to ventilate interface specifications. This evolution is shown in Figure 2. 3.

Figure 2. 3: WiMAX Evolution

Technology Summary of WiMAX

Scale able OFDM on downlink and uplink

Variable Spectrum Width from 1. 25 to 10 MHz

Up to 64 QAM, MIMO, Spatial Multiplexing, Beamforming

Mobile WiMAX deployed since 2008

IEEE802. 16m and Mobile WiMAX Release 2

Lower latency through faster MAC/signaling

Higher spectrum efficiency through more advanced and higher order MIMO solutions, including multiuser MIMO as well as lower MAC and PHY overhead.

Higher peak and user data rates using wide-band carriers (including 20 MHz) and multicarrier aggregation.

Enhanced coverage in high interference environments with improved preamble and control channel.

Support for higher mobility through a faster feedback mechanism and link adaption.

Flexible spectrum deployments (both FDD and TDD support contiguous bands)

The scenario and deployment of 4G in the near future

4G refers to the fourth generation of cellular wireless standards. It is a successor to 3G and 2G families of standards. The first was the move from 1981 analog (1G) to digital (2G) transmission in 1992. This was followed, in 2002, by 3G multi-media support, spread spectrum transmission and at least 200 kbit/s, soon expected to be followed by 4G, which refers to all-IP packet-switched networks, mobile ultra-broadband (gigabit speed) access and multi-carrier transmission. Pre-4G technologies such as mobile WiMAX and first-

release 3G Long term evolution (LTE) have been available on the market since 2006 and 2009 respectively.

According to the members of the 4G working group, the infrastructure and the terminals of 4G will have almost all the standards from 2G to 4G implemented. Although legacy systems are in place to adopt existing users, the infrastructure for 4G will be only packet-based (all-IP). Some proposals suggest having an open Internet platform. Technologies considered to be early 4G include: Flash-OFDM, the 802. 16e mobile version of WiMax (also known as WiBro in South Korea), and HC-SDMA (see iBurst).

Question 8The public cellular service operator in Malaysia are subjected to mandatory standards for Quality of Service (QoS) or Grade of Service (GOS) by Malaysian Communication and Multimedia Commission (MCMC). List various parameters and schemes used for providing QoS/GOS in cellular network and discuss their advantages/disadvantages to the subscribers and operators. How can QoS provisioning be managed in the future 4G cellular network?

There is two ways to measure the quality of voice services, Grade of Service (GoS) and the Quality of Service (QoS). GOS can be describe as a chances of a call in a circuit group being blocked or delayed for more than a specified interval and can be expressed as a vulgar fraction/decimal fraction. This is likely to happen to the busy hour when the traffic intensity is the greatest. Grade of service can viewed from the perspective of incoming versus outgoing calls, and is not necessarily equal in each direction or between different source-destination pairs.

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Quality of service (QoS) can also be called as voice grade or program grade which is a single circuit that is designed or conditioned to provide.

Equalization for amplification over a specified band of frequency or for this case of digital data transported via analogue circuit can be one of the quality criteria for such circuit. One of the aspects for mobile quality of service in cellular telephone circuits is the probability of abnormal termination of the call.

There is a lot of factor can affect the quality of service of the telecommunication network. From the customer`s point of view looking at this QoS can be describe as common phenomena and its judged by the user. However there is a standard metrics of QoS that can be used by the customer to measure the QoS. The coverage, accessibility and the audio quality is the indicator for this quality. For coverage, strength of the signal is measured using test equipment and this can be used to estimate the size of the cell. For accessibility it`s about determining the ability of the network to handle successful calls from mobile-fixed networks and from mobile-mobile networks. For audio quality it can be considers monitoring a successful for a period of time for the clarity of the communication channel. All these indicators are used by the telecommunications industry to judge the quality of service of the network.

QoS provisioning be managed in the future 4G cellular network

Nowadays, cellular network operators across the world have seen a rapid growth of mobile usage. Data usage per subscriber is increasing daily in particular and with the introduction of flat-rate tariffs and more advanced

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mobile devices. Services provider are moving from a single-service offering in the packet-switched domain to a multi-service offering by adding Value added services (VAS) that are also provided across the mobile broadband access. One of the examples of these Services is multimedia telephony and mobile-TV. These kind services have a different performance requirement in terms of the required bit rates and packet delays or any other examples. However solving these performance issues through over-provisioning typical is uneconomical due to the relatively high cost for transmission capacity in cellular access networks which includes radio spectrum and backhaul from the base stations. 4G broadband wireless technologies such as IEEE 802.16e/m and Third Generation Partnership Project (3GPP) – Long Term Evolution (LTE) have been designed with different QoS (Quality of Service) frameworks and means to enable delivery of the evolving Internet applications. QoS specifically for evolving Internet applications is a fundamental requirement to provide satisfactory service delivery to users and also to manage network resources.

QoS refers to the probability or ability of the network to provide a desired level of service for selected traffic on the network.

Service levels are defined in terms of throughput, latency (delay), jitter (delay variation) and packet errors or loss.

Different service levels are defined for different types or streams of traffic.

To supply QoS, the network identifies different types or streams of traffic and processes these traffic classes differently to achieve (or attempt to achieve) the desired service level for each traffic class.

The efficiency of any QoS scheme can be measured based on its ability to achieve the desired service levels for a typical combination of traffic classes.

4G wireless communication systems feel the requirement of transparent and seamless user roaming with end-to-end connectivity. These systems also required higher data rate, higher mobility support and QoS guarantees due to rapid development of wireless and mobile networks. All this requirements is possible for the operators to increase their service portfolio and for the users to experience context-rich and personalized services.

Advantages for Subscribers and Operators: Subscribers

Know that when the call was busy

Users may call for a long time without queuing

Easier for users to choose the best mobile phone operator. So, they know which one the operators has the best coverage.

Operators

Will know when the time is busy and how to solve the problem faster.

Always to take the opportunity to improve their network coverage.

Disadvantages for Subscribers and Operators: Subscribers

Cannot make a call especially during the emergency call.

Operators

Increase the cost in order to improve the network.

Will increase the number of cell in order to handle the large amount of subscribers.

SATELLITE COMMUNICATION QUESTION 10 The Very Small Aperture Terminal, VSAT service is becoming more popular in Malaysia. Obtain information on VSAT service operator in Malaysia including examples of application, network topology, user equipments, lease procedure and services offered and their data rate. How can a VSAT system accommodate subscriber that need higher data rate services. Introductions of VSAT

A Very Small Aperture Terminal (VSAT) is a two-way satellite ground station with a dish antenna that is smaller than 3 meters (most VSAT antennas range from 75 cm to 1.2 m). VSAT data rates typically range from narrowband up to 4 Mbit/s. VSATs access satellites in geosynchronous orbit to relay data from small remote earth stations (terminals) to other terminals (in mesh configurations) or master earth station “hubs” (in star configurations).

VSAT can be used for data, voice, video or internet applications [10]. It is used to communicate with to link together locations using satellite connectivity.

Figure 3. 1: A typical VSAT network depicting two way communications from remote terminals

through a VSAT satellite to a central hub.

MAXIS VSAT

VSATs are an ideal means of communication in areas where terrestrial infrastructure is unavailable or unreliable. As such VSAT services are able to bring distant or remote business communities closer by eliminating geographical barriers and challenges that previously existed. This in turn transfers to an increase in productivity and overall cost efficiency for such communities.

In addition to providing communication to remote areas, VSATs are also suitable in providing private networks in urban areas for organizations with many geographically dispersed branches that require connectivity to their Headquarters. VSAT services generally offer service reliability and availability that is equal to or higher than terrestrial services.

Below are examples of type Maxis VSAT Services that can be used depends on the complexity of the network and the communications requirements;

SCPC (Single Carrier Per Channel)

Satellite bandwidth is dedicated to a single source.

SCPC based design provides a point-to-point technology making it the VSAT equivalent.

Supports voice, data, video communications.

Advantages;

Simple and reliable technologies.

Low-cost equipment.

Figure 3. 2: SkyLine (SCPC) Service – hub to remote configuration

TDMA (Time Division Multiple Access)

Is a channel access method for shared medium network.

Allows several users to share the same frequency channel by dividing the signal into different time slots. In Figure 3 (d), all VSATs share satellite resource on a time-slot basis and the remote VSATs also use inroutes for communicating with the hub or TDMA channels. There could be several inroutes associated with one outroute.

Several VSATs share one inroute, so it also sharing the bandwidth. Typical inroutes operate at 64 or 128 Kbit/s. Critical to all TDMA schemes is the function of clock synchronization what is performed by the TDMA hub or master earth station.

The VSATs may also access the inroute on a fixed assigned TDMA mode, where in each VSAT is allocated a specific time slot or slots.

Figure 3. 3: Typical SkyNet (TDM/TDMA)-configuration supporting various interactive data applications.

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; Summarization of Maxis VSAT Services [6]:

Services

Service Description

Typical Users

SkyWayTMVSAT

Broadband data and Voice service.

Corporations with many branches requiring Broadband Data and telephony.

Corporations requiring Internet access.

Corporations or communities in remotes areas without telephone connectivity, i. e. plantations, timber camps and remote villages.

SkyLine VSAT

Dedicated leased line for point-to-point and point-to-multipoint connectivity.

Corporations requiring dedicated links for communications between its HQ and branches.

SkyLine-Plus VSAT

Dedicated leased line with Frame Relay technology for mesh connectivity.

Corporations requiring dedicated links for communications between sites within the VSAT network.

Gyro-Stabilized VSAT

Specialized VSAT service for maritime and offshore oil rigs.

Upstream oil and gas corporations

Shipping companies.

The benefit of Maxis VSAT Services

Uniform service quality

All sites in the VSAT network receives the same high quality services, whether the location is urban or rural areas.

Reach

VSAT is a service that available anywhere no matter the place, whether in a remote area, forest or anywhere in the world.

High reliability & availability

VSAT networks offer high reliability as the points of failure are limited to two points means at any two locations in a communications link.

This ensures minimal downtime while the service availability for VSAT networks.

Question 11 Global Positioning System, GPS satellite is a navigation satellite that can offer services based on locations. Investigate among the service offered in Malaysia, user hardware and equipments, subscription (if any), and

their limitation in term of accuracy. Identify similar service to complement GPS system particularly for mobile and handheld environment.

The Global Positioning System (GPS), also known as Navstar, is a satellite based navigation system that can be used by anyone with appropriate receiver to pinpoint location on earth. The array of GPS satellites transmits highly accurate, time coded information that permits a receiver to calculate its exact location in terms of the latitude and longitude on earth as well as the altitude above the sea level [10].

GPS was developed by the U. S Air Force for the Department of Defense as a continuous global radio navigation system that all elements of the military services would use for precision navigation. GPS consists of three parts: the space segment, the control segment, and the user segment [10].

The space segment is composed of 24 to 32 satellites in medium Earth orbit and also includes the boosters required to launch them into orbit [10]. The space segment is the constellation of satellites orbiting above the earth. It contains transmitters which send highly accurate timing information to GPS receivers on earth. The receivers may be used on land, sea or air.

Figure 4. 1: GPS mapping aids are small enough to be mounted on a dashboard or stashed in a backpacker's pack. They are popular with boaters too.

Figure 4. 2: The GPS space segment

Figure 4. 2 shows the fully implemented GPS consists of 24 main operational satellites plus 3 active space satellites. The satellites are arranged in six orbits, each orbit containing 3 or 4 satellites.

User hardware and equipments

GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map [13].

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A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and more[13].

The GPS receivers are extremely accurate, thanks to their parallel multi-channel design. Garmin's 12 parallel channel receivers are quick to lock onto satellites when first turned on and they maintain strong locks, even in dense

foliage or urban settings with tall buildings. Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. Garmin® GPS receivers are accurate to within 15 meters on average [13].

Newer Garmin GPS receivers with WAAS (Wide Area Augmentation System) capability can improve accuracy to less than three meters on average. No additional equipment or fees are required to take advantage of WAAS. Users can also get better accuracy with Differential GPS (DGPS), which corrects GPS signals to within an average of three to five meters. The U. S. Coast Guard operates the most common DGPS correction service. This system consists of a network of towers that receive GPS signals and transmit a corrected signal by beacon transmitters. In order to get the corrected signal, users must have a differential beacon receiver and beacon antenna in addition to their GPS [13].

GPS satellites transmit two low power radio signals, designated L1 and L2. Civilian GPS uses the L1 frequency of 1575. 42 MHz in the UHF band. The signals travel by line of sight, meaning they will pass through clouds, glass and plastic but will not go through most solid objects such as buildings and mountains. A GPS signal contains three different bits of information – a pseudorandom code, ephemeris data and almanac data. The pseudorandom code is simply an I. D. code that identifies which satellite is transmitting information. You can view this number on your Garmin GPS unit's satellite page, as it identifies which satellites it's receiving [13].

Ephemeris data, which is constantly transmitted by each satellite, contains important information about the status of the satellite (healthy or

unhealthy), current date and time. This part of the signal is essential for determining a position. The almanac data tells the GPS receiver where each GPS satellite should be at any time throughout the day. Each satellite transmits almanac data showing the orbital information for that satellite and for every other satellite in the system [13].

The service offered in Malaysia /GPS Applications

The primary application of the GPS is military and related navigation. GPS is used by all services for ships, aircraft of all sort, and group troops. Civilian uses have also increased dramatically because of the availability of many low-cost portable receivers. Most cavitations applications involve navigation, which is usually marine or aviation- related. Hikers and campers and other outdoors sports enthusiasts also use GPS.

Commercial applications include surveying, mapmaking and construction. Vehicle location is a growing application for trucking and delivery companies, taxi, bus and train transportation. Police, fire, ambulance and forest service's also use GPS. GPS based navigation systems are now widely available as accessories in cars to provide a continuous readout of current vehicle location.

GPS is finding new applications every day. For instance, it is used to keep track of fleets of trunks. A GPS receiver in each trunk transmits its position data by way of a wireless connection, such as a wireless local- area network or cell phone. Many new cell phones contain a GPs receiver that automatically reports the location of the user people makes a 999 call. Most

location based services will be used for 999 calls, eventually other location services may be developed for cell phones. Not all cell phones use GPS. Some use a unique triangulation method based on the cell phone being able to be in touch with at least three call sites. Finally, GPS receivers are so inexpensive and accurate that they have led to a new hobby called geocaching. In this sport, one team hides an item or 'treasure' and then gives the other team coordinates to follow to find the treasure within a given time.

Limitation in term of accuracy

Factors that can degrade the GPS signal and thus affect accuracy include the following:

Ionosphere and troposphere delays – The satellite signal slows as it passes through the atmosphere. The GPS system uses a built-in model that calculates an average amount of delay to partially correct for this type of error.

Signal multipath – This occurs when the GPS signal is reflected off objects such as tall buildings or large rock surfaces before it reaches the receiver. This increases the travel time of the signal, thereby causing errors.

Receiver clock errors – A receiver's built-in clock is not as accurate as the atomic clocks onboard the GPS satellites. Therefore, it may have very slight timing errors.

Orbital errors – Also known as ephemeris errors, these are inaccuracies of the satellite's reported location.

Number of satellites visible – The more satellites a GPS receiver can “ see,” the better the accuracy. Buildings, terrain, electronic interference, or sometimes even dense foliage can block signal reception, causing position errors or possibly no position reading at all. GPS units typically will not work indoors, underwater or underground.

Satellite geometry/shading – This refers to the relative position of the satellites at any given time. Ideal satellite geometry exists when the satellites are located at wide angles relative to each other. Poor geometry results when the satellites are located in a line or in a tight grouping.

Similar service to complement GPS system particularly for mobile and handheld environment.

GPS-enabled Cell Phones

Motorola and Blackberry were the first GPS-enabled phones to proliferate the United States. Initially, Motorola’s iDEN phones were commonly used for employee tracking on the business-oriented Nextel network. Then GPS-enabled Blackberry phones, once used almost exclusively by corporate and government VIPs, began to penetrate the consumer market stimulated by the demand for phones with advanced messaging capability. Next came specialty devices produced under the names of “ Disney Mobile” and “ Wherify Wireless” targeting use by children and elderly. Now in 2009, a

variety of GPS-enabled phones and tracking services are available, as you can see from the ads on this page.

Locating People in an Emergency

Stimulated by the events of 11 September 2001, the demand for enhanced 911 (e911) emergency calling capabilities pushed forward GPS tracking technology in cell phones. At the end of 2005, all cell phone carriers were required to provide the ability to trace cell phone calls to a location within 100 meters or less.

Wireless Networks

Your phone may have GPS and “ know” exactly where it is, but it can’t “ tell” anyone else where you are unless you are connected to a wireless network. Here in the United States, the wireless networks used for GPS tracking are primarily those operated by cell phone carriers. It is not likely that you as an individual will negotiate network access with a carrier. It is more likely that you will select a solution including a cell phone provisioned to communicate in a certain way on a specific wireless network. List below are some carriers recommended for use with GPS cell phones and services.

T-Mobile / Cingular / AT&T – The Global System for Mobile (GSM)

communications as adopted by these carriers represents the network with the largest coverage footprint. Roaming agreements between these carriers provide end users with service throughout the country. GSM is also the prominent cellular network abroad.

Sprint / Nextel, not so much because of coverage, but because of their emphasis on data. Nextel has created their own data formats and communication protocols for high bandwidth mobile electronics applications. This company, who gave new meaning to the term “ walkie-talkie”, provides the most flexibility for the communication of GPS data between cell phones and location-based service providers. Recent co-operation between Sprint and Nextel has increased this network’s footprint.

It is important to note that Wi-fi complements the cellular grid, providing additional conduits for location information to pass through to the net’. Your phone has a unique electronic identifier and – if enabled – can pass this information, locating you within the geographic area covered by the hotspot. There should be little doubt that the vast radioscope of urban environments is being mapped and your participation in services like Google Latitude improve their ability to locate you out of cell range and hidden from GPS satellites. Always read the terms of service before deciding to agree.

Location-Based Services (LBS)

LBS providers have agreements with the wireless network carriers to receive data from a cell phone and make it accessible to you via an Internet web site or call center. Most all LBS providers will be able to tell you the approximate last known location, but beyond that, services offered will vary, depending on the type of cell phone and the capabilities of the service provider.

5) Accuttracking

Accutracking is a full-featured low-cost LBS provider using Motorola, Boost Mobile and Blackberry phones operating on the Sprint/Nextel network.

PND-based Mobile Resource Management Solutions

Garmin portable navigation devices (PNDs) are a key part of today's most useful, versatile and cost-efficient fleet monitoring solutions. Working with fleet management partners, Garmin PNDs provide the interactive navigation link that's been missing in fleet management systems [8].

Garmin provides a Fleet Management Interface Tool Kit to enable any Fleet Management solution provider the ability to plug their service into our PNDs for the complete customer solution [9].

Drivers now have a "screen" in their vehicle for real-time navigation, messaging, and job dispatch capabilities to help them be more efficient.[9]

Garmin PNDs are installed in each vehicle, along with an in-vehicle data transponder available through Garmin's Fleet Management Partners [9].

The Garmin PNDs double as navigators and mobile data terminals in the vehicle, while the "black box" data transponder unit provides seamless connectivity to the monitoring center via a wireless mobile data network. Garmin's fleet management and dispatch messaging interface enables direct-to-driver communication via text messaging, as well as instant re-routing with "new destination" message prompts [9].

Available sensor technology lets users track such parameters like:

Vehicle location

Speed and direction of travel

Distance travel

Battery and thermostat levels

Cargo temperature

Elapsed time

Fuel status

Idle times

Number of stops

Cargo door access

Garmin Mobile XT is easy and can transform Smartphone into a turn-by-turn navigator. The advantage is users not required to subscribe. Garmin Mobile® XT also contains detailed POI, maps and all the navigation software pre-loaded on the data card with Mini Micro or SD adapter.

Garmin Mobile SDK

For developers wishing to incorporate Garmin Mobile XT into an existing application, Garmin offers a set of SDKs across Windows Mobile, Palm, and Symbian operating systems [8]. These SDKs provide the application with access to GPS information, map interaction, and routing by leveraging

Garmin's software on the same mobile device. Garmin Mobile XT is compatible with devices that include embedded GPS or paired to a GPS receiver via USB/Serial connection. (NMEA 0183 data format). For devices that don't include a GPS chip, customers and application providers can pair Garmin Mobile XT with Garmin's Bluetooth hardware package, Garmin Mobile 10 [HYPERLINK " https://buy.garmin.com/shop/shop.do?cid= 138&pid= 9796? for Smartphones.](https://buy.garmin.com/shop/shop.do?cid=138&pid=9796)

By utilizing the SDK for Smartphones users can:

Access the data such as GPS status, position, time and velocity

Create points at ;

- A specified latitude and longitude.
- The location of an address.
- The location the user selects from a map.
- The location of an item the user selects through the find menu.

Get information about;

- a point that we want to know.
- display a window showing the details of a point including its location on a map.
- create a route from the current location to a point.