

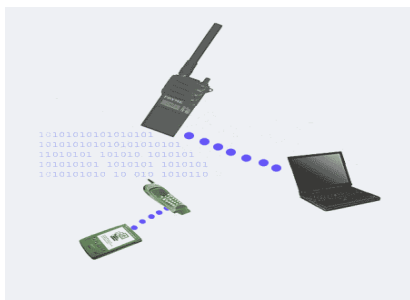
MOBILE COMPUTING

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Abstract: *Mobile Computing has fast become an important new paradigm in today's world of networked computing systems. Ranging from wireless laptops to cellular phones and WiFi/Bluetooth-enabled PDAs to wireless sensor networks, mobile computing has become ubiquitous in its impact on our daily lives. The debut of iPhones and the proliferation of other handheld devices has spurred excitement and interest in this evolving field. In this seminar, we will study the state-of-the-art in both the research and commercial communities with respect to mobile computing. We will investigate standard protocols and platforms, the capabilities of today's commercial devices, and proposed next-generation solutions. In the process, we will seek to gain an improved understanding about where the field is headed, and what is the importance in the mobile computing.*

I. INTRODUCTION

Mobile Computing : A technology that allows transmission of data, via a computer, without having to be connected to a fixed physical link. Mobile voice communication is widely established throughout the world and has had a very rapid increase in the number of subscribers to the various cellular networks over the across these cellular networks. This is the principle of mobile computing. Technology as it allows users to transmit data from remote locations to other remote or fixed locations. This proves to be the solution to the biggest problem of business people on the move - mobility. In this article we give an overview of existing cellular networks and describe in detail the CDPD technology which allows data communications across these networks. Finally, we look at the applications of Mobile Computing in the real world.



II. EXISTING CELLULAR NETWORK ARCHITECTURE

Mobile telephony took off with the introduction of cellular technology which allowed the efficient utilisation of frequencies enabling the connection of a large number of users. During the 1980's analogue technology was used. A cellular network consists of mobile units linked together to switching equipment, which interconnect the different parts of the network and allow access to the fixed Public Switched Telephone Network (PSTN). The technology is hidden from

view; it's incorporated in a number of transceivers called Base Stations (BS). Every BS is located at a strategically selected place and covers a given area or cell - hence the name cellular communications. A number of adjacent cells grouped together form an area and the corresponding BSs communicate through a so called Mobile Switching Centre (MSC). The MSC is the heart of a cellular radio system. It is responsible for routing, or switching, calls from the originator to the destination. It can be thought of managing the cell, being responsible for set-up, routing control and termination of the call, for management inter MSC hand over and supplementary services, and for collecting charging and accounting information. The MSC may be connected to other MSCs on the same network or to the PSTN.



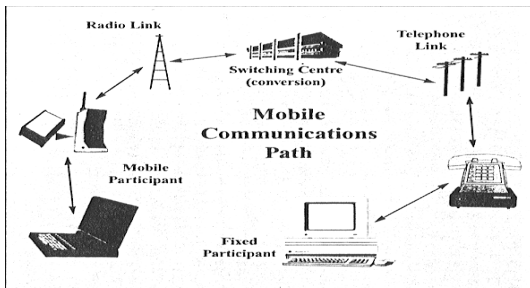
A. Mobile Switching Centre

The frequencies used vary according to the cellular network technology implemented. For GSM, 890 - 915 MHz range is used for transmission and 935 - 960 MHz for reception. The DCS technology uses frequencies in the 1800MHz range while PCS in the 1900MHz range. Each cell has a number of channels associated with it. These are assigned to subscribers on demand. When a Mobile Station (MS) becomes 'active' it registers with the nearest BS. The corresponding MSC stores the information about that MS and its position. This information is used to direct incoming calls to the MS. If during a call the MS moves to an adjacent cell then a change of frequency will necessarily occur - since adjacent cells never use the same channels. This procedure is called hand over and is the key to Mobile communications. As the MS is approaching the edge of a cell, the BS monitors the decrease in signal power. The strength of the signal is compared with adjacent cells and the call is handed over to the cell with the strongest signal. During the switch, the line is lost for about 400ms. When the MS is going from one area to another it registers itself to the new MSC. Its location information is updated, thus allowing MSs to be used outside their 'home' areas.



B. Data Communications

Data Communications is the exchange of data using existing communication networks. The term data covers a wide range of applications including File Transfer (FT), interconnection between Wide-Area-Networks (WAN), facsimile (fax), electronic mail, access to the internet and the World Wide Web (WWW).



1. Mobile Communications Overview

Data Communications have been achieved using a variety of networks such as PSTN, leased-lines and more recently ISDN (Integrated Services Data Network) and ATM (Asynchronous Transfer Mode)/Frame Relay.

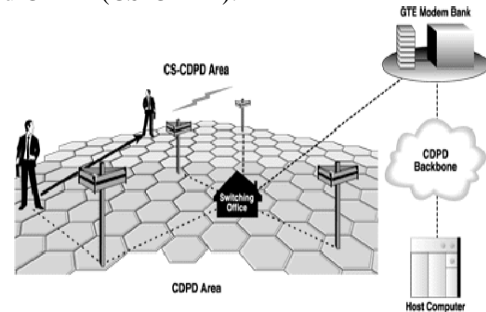
Circuit switching implies that data from one user (sender) to another (receiver) has to follow a prespecified path. If a link to be used is busy, message can not be redirected, a property which causes many delays.

Packet switching is an attempt to make better utilisation of the existing network by splitting the message to be sent into packets. Each packet contains information about the sender, the receiver, the position of the packet in the message as well as part of the actual message. There are many protocols defining the way packets can be sent from the sender to the receiver. The most widely used are the Virtual Circuit-Switching system, which implies that packets have to be sent through the same path,

III. CDPD TECHNOLOGY

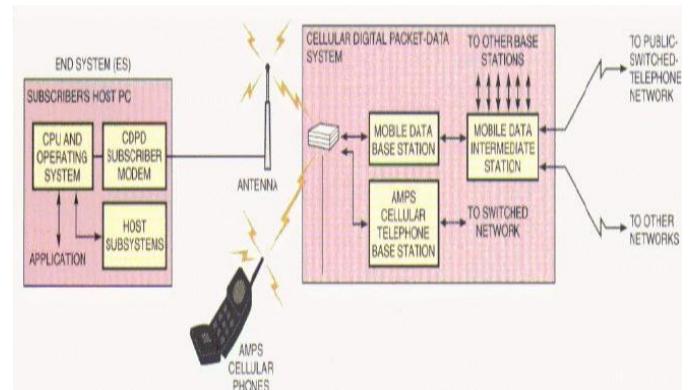
Today, the mobile data communications market is becoming dominated by a technology called CDPD. There are other alternatives to this technology namely Circuit Switched Cellular, Specialised Mobile Radio and Wireless Data Networks. As can be seen from the table below the CDPD technology is much more advantageous than the others. CDPD's principle lies in the usage of the idle time in between existing voice signals that are being sent across the cellular

networks. The major advantage of this system is the fact that the idle time is not chargeable and so the cost of data transmission is very low. CDPD networks allow fixed or mobile users to connect to the network across a fixed link and a packet switched system respectively. In the case of a mobile end user, the user can, if CDPD network facilities are non-existent, connect to existing circuit switched networks and transmit data via these networks. This is known as Circuit Switched CDPD (CS-CDPD).



A. Circuit Switched CDPD

Service coverage is a fundamental element of providing effective wireless solutions to users and using this method achieves this objective. Where CDPD is available data is split into packets and a packet switched network protocol is used to transport the packets across the network. This may be of either Datagram or Virtual Circuit Switching form. The data packets are inserted on momentarily unoccupied voice frequencies during the idle time on the voice signals. CDPD networks have a network hierarchy with each level of the hierarchy doing its own specified tasks.



B. CDPD Overview

The hierarchy consists of the Following levels :

1. Mobile End User Interface:

Using a single device such as a Personal Digital Assistant or personal computer which have been connected to a Radio Frequency (RF) Modem which is specially adapted with the antennae required to transmit data on the cellular network, the mobile end user can transmit both data and voice signals. Voice signals are transmitted via a mobile phone connected to the RF Modem Unit. RF Modems transfer data in both forward and reverse channels using Gaussian Minimum Shift Keying (MSK) modulation, a modified form of Frequency Shift Keying (FSK) at modulation index of 0.5.

2. Mobile Data Base Station (MDBS):

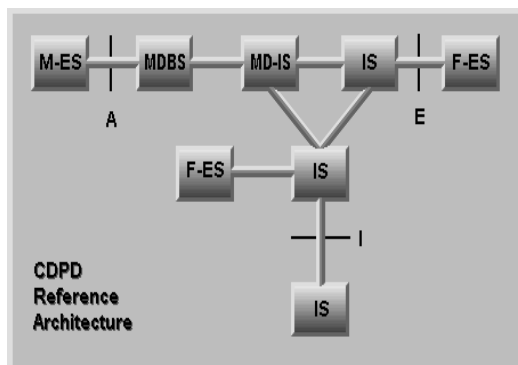
In each cell of the cellular reception area, there is a Mobile Data Base Station (MDBS) which is responsible for detection of idle time in voice channels, for relaying data between the mobile units and the Mobile Data Intermediate Systems (MDIS), sending of packets of data onto the appropriate unoccupied frequencies as well as receiving data packets and passing them to the appropriate Mobile end user within its domain.

3. Mobile Data Intermediate Systems (MDIS):

Groups of MDBS that control each cell in the cellular network reception area are connected to a higher level entity in the network hierarchy, the Mobile Data Intermediate Systems. Connection is made via a wideband trunk cable. Data packets are then relayed by MDBS to and from mobile end users and MDIS. These MDIS use a Mobile Network Location Protocol (MNLP) to exchange location information about Mobile end users within their domain. The MDIS maintains a database for each of the M-ES in its serving area. Each mobile unit has a fixed home area but may be located in any area where reception is available.

4. Intermediate Systems (IS):

MDIS are interconnected to these IS which form the backbone of the CDPD system. These systems are unaware of mobility of end-users, as this is hidden by lower levels of the network hierarchy. The ISs are the systems that provide the CDPD interface to the various computer and phone networks. The IS's relay data between MDIS's and other IS's throughout the network. They can be connected to routers that support Internet and Open Systems Interconnection Connectionless Network Services (OSI-CLNS), to allow access to other cellular carriers and external land-based networks.



IV. CDPD NETWORK

A. CDPD Network Reliability

There are some actions that are necessary in order to obtain reliability over a network.

1. User Authentication

The procedure which checks if the identity of the subscriber transferred over the radio path corresponds with the details held in the network.

2. User Anonymity

Instead of the actual directory telephone number, the International Mobile Subscriber Identity (IMSI) number is

used within the network to uniquely identify a mobile subscriber.

3. Fraud Prevention

Protection against impersonation of authorized users and fraudulent use of the network is required.

4. Protection of user data

All the signals within the network are encrypted and the identification key is never transmitted through the air. This ensures maximum network and data security.

The information needed for the above actions are stored in data bases. The Home Location Register (HLR) stores information relating the Mobile Station (MS) to its network. This includes information for each MS on subscription levels, supplementary services and the current or most recently used network and location area. The Authentication Centre (AUC) provides the information to authenticate MSs using the network, in order to guard against possible fraud, stolen subscriber cards, or unpaid bills. The Visitor Location Register (VLR) stores information about subscription levels, supplementary services and location for a subscriber who is currently in, or has very recently been in, that area.

B. Applications

- 1) For Estate Agents
- 2) Emergency Services
- 3) Credit Card Verification
- 4) Taxi/Truck Dispatch
- 5) Electronic Mail/Paging

1) For Estate Agents

Estate agents can work either at home or out in the field. With mobile computers they can be more productive. They can obtain current real estate information by accessing multiple listing services, which they can do from home, office or car when out with clients. They can provide clients with immediate feedback regarding specific homes or neighborhoods, and with faster loan approvals, since applications can be submitted on the spot. Therefore, mobile computers allow them to devote more time to clients.

2) Emergency Services

Ability to receive information on the move is vital where the emergency services are involved. Information regarding the address, type and other details of an incident can be dispatched quickly, via a CDPD system using mobile computers, to one or several appropriate mobile units which are in the vicinity of the incident. Here the reliability and security implemented in the CDPD system would be of great advantage.

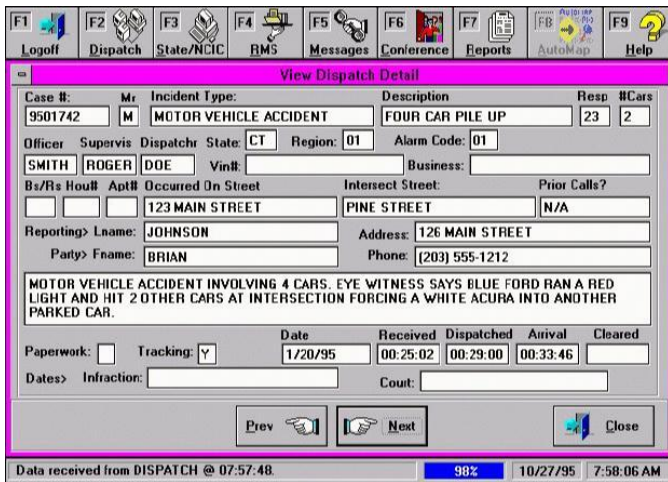


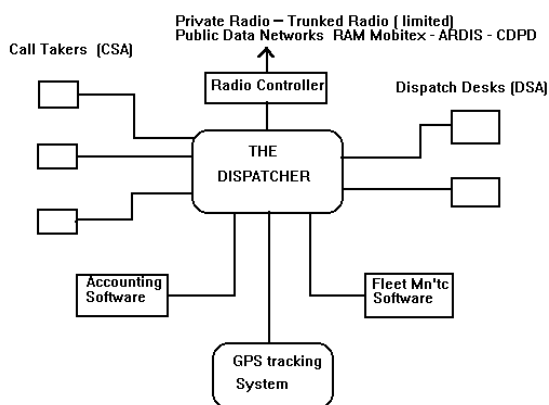
Figure 1: Police Incident Information Screen

3) Credit Card Verification

At Point of Sale (POS) terminals in shops and supermarkets, when customers use credit cards for transactions, the intercommunication required between the bank central computer and the POS terminal, in order to effect verification of the card usage, can take place quickly and securely over cellular channels using a mobile computer unit. This can speed up the transaction process and relieve congestion at the POS terminals.

4) Taxi/Truck Dispatch

Using the idea of a centrally controlled dispatcher with several mobile units (taxis), mobile computing allows the taxis to be given full details of the dispatched job as well as allowing the taxis to communicate information about their whereabouts back to the central dispatch office. This system is also extremely useful in secure deliveries ie: Securicor. This allows a central computer to be able to track and receive status information from all of its mobile secure delivery vans.



5) Electronic Mail/Paging

Usage of a mobile unit to send and read emails is a very useful asset for any business individual, as it allows him/her to keep in touch with any colleagues as well as any urgent developments that may affect their work. Access to the Internet, using mobile computing technology, allows the

individual to have vast arrays of knowledge at his/her fingertips.

FUTURE PROSPECTS

1. With the rapid technological advancements in Artificial Intelligence, Integrated Circuitry and increases in Computer Processor speeds, the future of mobile computing looks increasingly exciting.
2. With the emphasis increasingly on compact, small mobile computers, it may also be possible to have all the practicality of a mobile computer in the size of a hand held organizer or even smaller.
3. Use of Artificial Intelligence may allow mobile units to be the ultimate in personal secretaries, which can receive emails and paging messages, understand what they are about, and change the individuals personal schedule according to the message. This can then be checked by the individual to plan his/her day.
4. The working lifestyle will change, with the majority of people working from home, rather than commuting. This may be beneficial to the environment as less transportation will be utilised. This mobility aspect may be carried further in that, even in social spheres, people will interact via mobile stations.

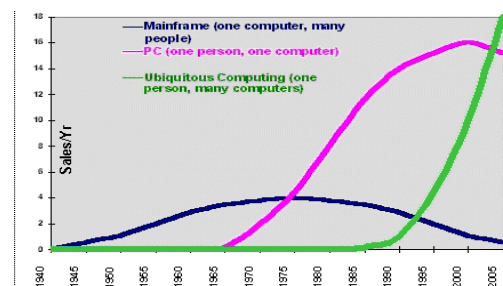


Figure 3: Major Trends in Computing

Indeed, technologies such as Interactive television and Video Image Compression already imply a certain degree of mobility in the home, ie. home shopping etc. The future of Mobile Computing is very promising indeed, although technology may go too far, causing detriment to society.

CONCLUSION

According to my aims and objectives of this paper I have done the detailed research and get the knowledge about it and the factors that need to be consider carefully. At this stage we are facing different types of problems and threats to the mobile industry, the two major aspects are the security and the usability issue. Detailed analysis of security issues is very important at least for a mobile wireless device, there are numbers of ways that it can be compromised, but I would like to draw an attention on the usability issues as well. They both need to be carefully planned and designed that the mobile user or target audience get used to it easily, effectively and securely.

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