4 Diffusion Mechanisms.

4.1 Competitive Collaboration

In order for companies to survive nowadays they need each other. This is because there is not enough capital to sustain companies on their own from research and development through to distributing products to the end user. In order to overcome this, companies work together, even though they are competitive.

Hamel *et al* [24] say that collaboration between competitors is fashionable. France's Thomson and Japan's Sony manufacture videocassette recorders and Siemens and Phillips develop semiconductors. These companies do work together, even though they are in competition with each other, through infrastructures like co-operative research, outsourcing agreements and joint ventures. This is what is called "competitive collaboration". It seems to trigger unease about long-term consequences, but a strategic alliance can strengthen both companies against outsiders even as it weakens one partner *vis-à-vis* the other. Hamel *et al* [24] say that it takes so much money to develop new products and to penetrate new markets, that few companies can do this alone in every situation. Motorola needs Toshiba's capacity for distribution into the Japanese semiconductor market.

Companies that benefit the most from competitive collaboration adhere to a powerful set of principles. Hamel *et al* [24] say that collaboration is competition in a different form, so companies have to be strategic when they engage in collaboration. Successful companies never forget that their new partners may be out to disarm them. They enter alliances with clear strategic objectives and they also understand how their partners' objectives will affect their success.

Harmony is not the most important measure of success. Indeed, occasional conflict may be the best evidence of mutually beneficial collaboration. Few alliances remain win-win undertakings forever. A partner may feel content even as it unknowingly surrenders core skills.

According to Hamel *et al* [24] say *Cupertino* has limits. Companies must defend against competitive compromise. A strategic alliance is a constantly evolving bargain, whose real terms go beyond the legal agreement or the aims of top management. What information is traded is determined from day to day, often by engineers and operating managers. Successful companies inform employees at all levels about which skills and technologies are off-limits to the partner and monitor what the partner requests and receive.

Hamel *et al* [24] emphasise that learning from partners is important. Successful companies view each alliance as a window on to their partners' broad capabilities. They use the alliance to build skills in areas outside the formal agreement and systematically diffuse new knowledge throughout their organisation.

Hamel *et al* [24] explain why it is important for companies to collaborate. Using an alliance to acquire new technologies or skills is not devious. It reflects the commitment and capacity of each partner to absorb the skills of each other.

They point out that strategic intent is an essential ingredient in the commitment to learning. The willingness of Asian companies to enter alliances represents a change in competitive tactics, not in competitive goals. NEC, for example, has used a series of collaborative ventures to enhance its technology and product competencies. It is the only company in the world with a leading position in telecommunications, computers and semiconductors - despite its investing less in research and development.

Hamel *et al* [24] also point out that a company's attitude towards collaboration is also of importance. A senior U.S. manager offered this analysis of his company's venture with a Japanese rival: "We complement each other well - our distribution capability and their manufacturing skill. I see no reason to invest upstream if we can find a secure source of product. This is a comfortable relationship for us".

An executive from this company's Japanese partner offered a different perspective; "When it is necessary to collaborate, I go to my employees and say this is bad, I wish we had these skills ourselves. Collaboration is second best. But I will feel worse, if after four years we do not know how to do what our partners know how to do. We must digest our skills".

Troubled laggards like Rover often strike alliances with surging latecomers like Honda. Having fallen behind in a key skill area (in this case that of manufacturing small cars), the laggard attempts to compensate for past failures. The latecomer uses the alliance to a close specific skill gap, in this case, learning to build small cars for a regional market. But the laggard that forges a partnership for short term gain may find itself in a dependency spiral: as it contributes fewer and fewer distinctive skills, it must reveal more and more of its internal operations to keep the partner interested.

Hamel *et al* [24] say the point is for a company to emerge from an alliance more competitive than when it entered. There are certain conditions under which mutual gain is possible, at least for a time: when the partners' strategic goals converge, while their competitive goals diverge. That is, each partner allows for the other's continued prosperity in the shared business. Philips and Du Pont collaborate in developing and manufacturing compact discs, but neither side invades the other's market. There is a clear upstream/downstream division of effort.

The size and market power of both partners is modest compared with industry leaders. This, forces each side to accept that mutual dependence may have to continue for many years. Long-term collaboration may be so crucial to both partners that neither will risk antagonising the other by an overtly competitive bid to appropriate skills or competencies. Each partner believes it can learn from the other and, at the same time, limit it, to proprietary skills.

For collaboration to succeed, each partner must contribute something distinctive, basic research, product development skills, manufacturing capacity and access to distribution channels. The challenge is to share enough skills, to create skills, to create advantage vis-à-vis companies outside the alliance while preventing a wholesale transfer of core skills to the partner. This is a very fine line to walk. Companies must select which skills and technologies they pass on to their partners carefully. They must develop safeguards against unintended informal transfers of information. The goal is to limit the transparency of their operations.

The type of skill a company contributes is an important factor in determining how easily its partner can internalise its skill. The potential for transfer is greatest when a partner's contribution is easily transported (in engineering drawings, on computer tapes, or in the heads of a few technical experts), easily interpreted (able to be reduced to commonly understood equations or symbols). And easily absorbed (the skill or competence is independent of any particular cultural context).

Many of the skills that migrate between companies are not covered in the formal terms of the collaboration. Top management puts together strategic alliances and sets the legal parameters for exchange, but what is actually traded, is determined by the day-to-day interactions of engineers, marketers and product developers. In other words, by who says what to whom, who gets access to what facilities and who sits on which joint committees. The most important deals ("I'll share this with you if you share that with me") may be struck four or five organisational levels below the point the deal was signed. Here lurks the greatest risk of unintended transfers of important skills.

Hamel *et al* [24] points out that limiting unintended transfers at the operating level requires careful attention to the role of gatekeepers, the people who control what information flows to a partner. A gatekeeper can be effective only if there are a limited number of gateways through which a partner can access people and facilities. Fujitsu's many partners all go through a single office, the "collaboration section", to request information and assistance from different divisions. Collegiality is a prerequisite for collaboration success, but too much collegiality should set off warning bells to senior managers. Limiting unintended transfers ultimately depends on employee loyalty and self-discipline.

Learning begins at the top. Senior management must be committed to enhancing their companies' skills, as well as to avoiding financial risk. But most learning takes place at the lower levels of an alliance.

Competitive collaboration also provides a way of getting close enough to rivals to predict how they will behave when an alliance unravels or runs its course. Knowledge acquired from a competitor-partner is only valuable after it is diffused through the organisation.

Whether a company controls 51% or 49% of a joint venture may be much less important than the rate at which each partner learns from the other. Companies that are confident of their ability to learn may even prefer some ambiguity in the alliance's legal structure. Ambiguity creates more potential to acquire skills and technologies. The challenge for Western companies is not to write tighter legal agreements, but to become better learners.

Collaboration has become the way to work in industry of late. Companies do not have enough capital to sustain all the business functions on their own and to become really profitable. Companies' get together to share skills and learn as much as they can from their partners, without having to compromise their business capabilities.

In essence, my research suggests that the cellular industry in South Africa is all about competitive collaboration. The suppliers need the service providers to add value to their handsets by providing airtime. On the other hand, the service providers need equipment in order to have airtime services. By the same token, it is imperative to have the cell phones distributed to the customer and the supplier depends on the service provider to distribute the cellular phones through their wholesalers, which are their cell shops etc.

4.2 Administrative Innovation

Venkatraman *et al* [25] says that diffusion mechanisms are viewed as institutional arrangements that serve to influence the exchange process. They include external mechanisms, such as long-term contracts, licensing agreements and partnership, as well as internal mechanisms, such as executive compensation, board composition and corporate culture.

They illustrate their point by discussing the adoption of one external-governance mechanism (joint venture) and one internal-governance mechanism (M-form, i.e. multidivisional organisation structure).

The conceptual model is rooted in the notions of "imperfect imitability" with emerging resource -based theory of the firm (Barney 1991). A comparison is made of the relative explanatory powers of the internal-influence diffusion models while also examining the adequacy of a more fully specified mixed-influence model.

The empirical analysis is based on the following: The adoption of the joint venture in one specific industry sector. Namely the information technology (I.T.) sector, with generalizability assessed through a multisector dataset; and the adoption of M-form structure by extending the work of (Mahajan *et al* 1988), through significant analytical refinements that are more powerful and that overcome certain econometric limitations.

On the basis of the differential degree of immitability, internal and external influences are conceptualised as appropriate process determinants of diffusion for the two governance mechanisms.

Venkatraman *et al* [25] say that their perspective on the diffusion of innovation is as follows. The diffusion of an innovation is defined as the process by which the innovation "is communicated through certain channels over time among the members of a social system" according to Rogers [7]. Empirical studies have been concerned with developing analytical models to predict the patterns of adoption and the speed of the diffusion. It has been found that cumulative adoption be represented by an S-curve with four important elements, namely innovation, channels of communication, time and the social system. The underlying behaviour theory is that, as more firms that have adopted the innovation come into contact with non-adopting firms, their superior performances, resulting from the earlier adoption of the particular innovation, will encourage non-adopters to adopt the innovation.

A definition of administrative innovation is "involving significant changes in the routines used by the organisation to deal with its tasks of internal arrangements and external alignments" according to Ventraman *et al* [25].

This definition captures the following elements:

- The critical notion of first-time adoption by the organisation unit;
- Changes in the routines and procedures of organisation and management, that are associated with substantial "set-up" costs and organisational disruption; and
- A broader view of administrative tasks as organisation-environment co-alignment reflecting both internal arrangements as well as external alignments.

Venkatraman *et al* [25] talk of joint venture as an administrative innovation. The point of departure in this research is the argument that the first-time adoption of joint venture by an organisation is an administrative innovation.

This is because an organisation's first adoption of a joint venture represents a fundamental shift away from the established mode of conducting an economic activity, namely hierarchy versus market. It requires substantially modified business processes or organisational repertoires to deliver products and services in the marketplace, as well as to deal with other firms and the general environment. These may involve liaison roles, joint decision-making for allocation of resources, structuring of tasks, redistribution of authority and specification of criteria for performance assessment that span across organisation boundaries.

4.3 Technology Transfer

Bessant *et al* [26] call the process through which technology moves from outside sources to the organisation "technological transfer". An interactive examination of the process reviews some of the policy mechanisms, which enable it to proceed effectively and, in particular, looks at the role, which can be played by consultants as an integral part of policies aimed at stimulating the diffusion of industrial practice.

An emerging, interactive model, for technology transfer. What is transferred may take many forms. It could be a tangible form of a new piece of process equipment or embodied in a prototype product. It could, equally, be in the form of knowledge, codified via a patent licence or a set of design specifications. It may be transferred embodied in physical form or it may be carried over in the knowledge and experience of a particular individual recruited to a firm. Technological knowledge may be coded in explicit form or held in a tacit mode, part of the information and knowledge derived from experience in particular activities.

A second point made about technological transfer is that it is not an instantaneous event, but a time-based process involving several stages. These range from initial recognition of an opportunity or need, through search, comparison, selection, acquisition, implementation and long-term use (involving learning and development). This is a complex activity involving multiple actors and elements and various patterns of interrelationship. Each stage in the process may be influenced a different set of issues.

Transactions in the transfer of technology are not always made on a one-to-one basis, but may also be made on a many-to-one or one-to-many or many-to-many basis. In addition, they may not always proceed directly, but may operate through various forms of intermediary.

Technology is a multi-dimensional commodity and a particular package might not be available from a single supplier but from a combination of sources. Technology does not remain static over time, but is constantly being modified. Thus each transaction in technology transfer is, to some extent, unique and company-specific, i.e. involving a particular configuration of technology.

Bessant *et al* [26] add that empirical evidence on innovation adoption suggests that a much wider set of influences and motives are at work and that it is the perceived, rather than the objective, characteristics of innovations, which affect the adoption decision. Thus policy mechanisms need to be flexible enough to raise awareness and to permit potential users to explore and evaluate technologies against their own particular and subjective criteria prior to adoption.

Diffusion studies have highlighted the importance of 'opinion leaders' in industrial communities. If such leaders can be identified and technology can successfully be transferred to them, there is a greater likelihood of other firms following suit.

Where a particular pattern of innovation (technological trajectory) becomes established, it helps define the track along which organisations in a given sector will tend to move in order to remain competitive. This bandwagon effect has both positive and negative implications. In a positive sense, it has an accelerator effect on policy makers, encouraging transfer of particular technologies across the population of firms.

There is always an awareness gap amongst smaller enterprises, which do not make use of the traditional channels of communication. Policy measures thus need to include an information and diffusion component which makes extensive use of a wide range of channels. Traditional interactive models often underestimate the extent of user/producer integration in the process of innovation and re-innovation.

Bessant *et al* [26] point out that the implicit assumption often exists that the point at which adoption takes place is the end of the innovation process, yet experience suggests that simply possessing a technological resource is no guarantee of its effective use. Building technological competence requires a learning process, to absorb and optimise the technology. The implication for policy support is that, it should cover the post-adoption period as well as promote or facilitate adoption.

There is often a strong cultural dimension embedded within a particular technology that, when such technology is transferred to a different location, implementation may fail because of an underlying cultural mismatch.

Bessant *et al* [26] say that the diversity of the consultant's role and the flexibility of modes of operation and interaction mean that there is considerable scope for consultants to act as key bridging intermediaries across a wide range of users.

Experience suggests that there are a number of ways in which consultants can improve the operation of the innovation process. Firstly, there is the direct transfer of specialised knowledge, which has already been obtained and assimilated by the consultants. Secondly there is either implicit or explicit experience sharing. Here the consultants act like bees, cross-pollinating between firms and carrying experiences and ideas from one location or context into another. The third role is that of a "marriage broker", who provides users with a single point of contact through which to access a wide range of specialist services. These might be available from the consultants in question or they might be provided by other organisations known to the consultant. In this role, the consultant acts as a channel to and selection aid for the user.

The fourth role is a diagnostic one, in which consultants' help users articulate and define their particular innovation needs. Many users or firms lack the resources or experience to understand and prioritise their problems in such a way that external resources and opportunities can be utilised effectively. Consultants can provide a valuable input to this first stage of innovation, by creating a strategic framework for change. They can also move from identifying needs in this fashion, to suggesting means whereby the problems identified can be solved.

Technology transfer is the process by which technology moves from an outside source into an organisation. It is a process that takes a lot of time and involves interactions with a lot of players with different levels of skill and technical know-how. Movement of personnel from company to company, design specifications and prototypes can achieve technology transfer. Because of the complexity of technology transfer it is sometimes important to use consultants as a bridge. They can use their vast knowledge and experience to transfer technology and implement it in different environments, with different cultures.

5 Technologies

5.1 Introduction

In this chapter the author gives an in-depth description of technologies that are being diffused in the cellular industry. This is to illustrate the functionality and capability of the technologies. Having appreciated the functionality and capability of the technologies then it may perhaps clarify why these technologies are being assimilated and diffused at such a high rate.

Burgelman *et al* [19] say, "technology refers to the theoretical and practical knowledge, skills and artifacts that can be used to develop products and services as well as their production and delivery systems. Technology can be embodied in people, materials, cognitive and physical processes, plant, equipment and tools. Key elements of technology may be implicit, existing only in embedded form (e.g. trade secrets based on know-how). Craftsmanship and experience usually have a large tacit component, so that important parts of technology may not be expressed or codified in manuals, routines and procedures, recipes, rules of thumb, or other explicit articulations.

The criteria for success regarding technology include technical expertise (can it do the job?) as well as commercial aspects (can it do the job profitably?). Technologies are usually the outcome of development activities to put inventions and discoveries to practical use".

5.2 Cellular Telephone Technology

For the purposes of this research into cellular telephone technology, the focus will be on Ericsson and Nokia. Nokia has produced the Nokia 9110 Communicator as a new product in the communicator product segment. The communicator is a product which combines digital voice, data communications applications (e.g. fax, e-mail, SMS) and other functions (e.g. calendar, notes, contacts) into a single unit.

The Nokia 9110 Communicator provides easy and efficient communications in one product. It could be described as an efficient mobile office and some of its features include:

- Send and receive faxes;
- Send and read e-mail with your communicator;
- Send and receive messages in a user-friendly way;
- A full-featured GSM phone;
- Excellent operation times.
- Hands- free phone;
- Easy use for conference calls;
- Easy to learn to use; and
- Calendar and contacts -compatible with popular PIM applications (e.g. Microsoft Outlook 97/98).

According to Nokia [27], Nokia telephones are now moving from being simple tools for passing messages to new communicators. They are now geared to be able to phone, fax, e-mail, and save files, including spreadsheets. They have memory cards, which are thumbnail sized diskettes with a capacity of 4MB. They even give one direct access to the Internet. An application protocol is needed for the phones to function in this manner, and Nokia has developed a new protocol called, which stands for Wireless Application Protocol (WAP).

Technically speaking, mobile phones are no longer just telephones. They are now communications devices capable of running applications and communicating with other devices and applications over a wireless network.

WAP specifies two essential elements of wireless communication, namely an end-to-end application protocol and an application environment based on a browser. The application protocol is a layered communication protocol that is embedded in each WAP-enabled user agent. The network side includes a server component, implementing the other end of the protocol, which is capable of communicating with any WAP user agents.

The second supplier that will be discussed, is ***Ericsson***.

Ericsson is a world-leading supplier of equipment for the telecommunications systems and related terminals. It produces advanced systems and products for wired and mobile communications in public and private networks.

Ericsson's [28] strategy states: "Ericsson's mission is to understand our customer's opportunities and needs and to provide communications solutions better than any competitor". In doing this, Ericsson can offer its shareholders a competitive return on their investments.

Ericsson has launched a cell phone called the T28. It is the smallest dual band mobile phone for GSM 900. Based on new technology and design platforms this is the most innovative phone developed by Ericsson. The T28 has up-to-date technology including the new frequencies specified by the Radio communications Committee, e-GSM or extended GSM.

It boasts full graphic display for easy readability and features an active flip, which lets the user start and end a call. The interior of the phone contains new functions, which will simplify communications efficiently for consumers. One of the many new features is voice dialling, which lets you contact someone simply by saying their name.

The T28 is loaded with advanced software that has been developed and utilised to ensure the user interface is faster and easier to navigate. Navigation is made simple by the use of icons, intuitive help texts and shortcuts to certain functions. Among the new features are the profiles, which let one adjust the phone to different situations. For instance, one can restrict certain calls or allow certain calls to get through during a meeting, or choose different ring signals and volumes, including the vibrating alert, for different incoming calls. The phone handles 37 languages. It is based on a new 3-volt platform, which draws less current, thereby ensuring longer talk and standby times, an overall improvement in smaller phones. Talk time is estimated at up to four and half-hours and the standby time is up to 200 hrs.

T28 also has intelligent accessories. For instance, if the phone is simply placed in vehicle-hands free set. The profile feature can automatically activate " vehicle mode", turning on the display and turning up the ring signal, so that it can be heard above the noise of traffic.

Furthermore, when one puts the phone on the desktop charger, it will automatically divert incoming calls to another telephone number, e.g. one's fixed line.

Other features include:

- Phone book with over 250 names;
- Conference Calls;
- Call/hold /Call wait;
- Alternative line service;
- Automatic world clock (Nitz);
- Two games Tetris and Solitaire;
- Easy access to the 20 most recent numbers dialled, calls received and calls missed;
- Advice on charging;
- Fixed dialling numbers;
- Call barring;
- Call line identification; and
- SIM Application Toolkit.

Ericsson advertises the T28 as a dual band phone for GSM 900 and 1800 bands, with intelligent network selection between the bands making roaming much easier and more flexible. It has been designed to satisfy the needs of an increasingly sophisticated market and thus includes vibrating alert, an important feature for any upmarket phone today. It even has a voice recognition feature that can be used not only to initiate calls but also to reject incoming calls.

Globalstar uses Ericsson, Qualcomm and Telltal telephones, but for the purpose of this research the focus will remain on Ericsson.

For a long-time, the dream of mobile phone users was to have total global coverage. With the current cellular systems this is not possible, because the land-based network cannot cover all areas economically and it is virtually impossible to cover the oceans with fixed cellular networks. Satellite technology will, however, offer-near total coverage to mobile phone users on specific satellite systems, mainly Iridium and Globalstar.

For this research, the area of interest in satellite telephones is Kyocera and Motorola. These two companies have developed technology to be used on satellite infrastructure.

5.3 Kyocera and Motorola pagers:

The Kyocera and Motorola pagers deliver a worldwide messaging tool that fits in the palm of the hand. It offers a flexible, cost-effective global communications package that receives all your messages, wherever your travels take you.

Its features are:

- Battery life of 30 days (1.5v AA alkaline battery); and
- Memory of 128 KB RAM.

5.4 Kyocera Satellite-Only Telephone

This telephone is dedicated to Iridium World Satellite Services. Its features are:

- Graphic LCD display;
- Multiple language display;
- World alarm timer;
- Choice of ringer alerts;
- Voice memo recording;
- Phone book memory;
- Continuous talk time is 100 min;
- Continuos Standby time is 24 hrs;
- Data speed of 2,400bps (available 1999).

5.5 Kyocera Multi-Mode Telephone

The Kyocera multi-mode phone gives one the versatility of terrestrial wireless services and access to the global coverage of the Iridium satellite network. Within cellular coverage areas, one can use one's Kyocera Iridium telephone on the local network. Outside the coverage areas, one snaps it the Iridium satellite attachment unit and one is instantly connected to the largest, most comprehensive satellite network in the world. The telephone's features are:

- Iridium-ready satellite;
- GSM cellular attachment;
- Phone unit;
- Continuous talk time of up to two hours / 100 minutes up to four to five and a half hours with optional battery;
- Continuous standby time of 70-160 hours up to 24 hours (48 hours with optional battery); and
- Data speed of 9600 bps to 2400 bps (available from 1999).

5.6 Satellite Telephone Technologies

There must be an infrastructure to cater for satellite telephones. The facilitators in this case are satellites that orbit above a certain distance from the earth. These satellites are different in orbit.

Forrester [29] discusses the orbital differences between geosynchronous, medium and low earth orbit satellites.

5.7 Geosynchronous Earth Orbit Satellite (GEOs):

GEO's orbit exactly 22,300 miles above the Equator, and take exactly 24 hours to complete an orbit, thereby holding themselves steady above a fixed spot.

A constellation of three GEOs could provide coverage to the entire planet, hence their popular use as lofty broadcast antennas while eminently suitable for broadcast applications, however, the 0,25 signal delay each way, plus further delay in ground-based switching, makes GEO use for mobile telecommunications awkward. In-orbit life is now tending towards 15 years and recent Proton launches give some GEOs a theoretical life approaching 25 years.

5.8 Medium Earth Orbit Satellites (MEOs):

A MEO's orbit is significantly closer to earth than that of a GEO satellite, at 1,500 to 6,500 miles. Although this proximity reduces signal delays, it also means a MEO's signal area is smaller than that of a GEO. In other words, more MEOs are needed to cover the same area as a GEO. And because the nearer to earth a satellite is, the shorter its orbital life; MEOs' life expectancies are approximately six to 12 years. Thus, a MEO-based satellite system requires more launches to maintain a system than a GEO-based one and users must redirect antennas as satellite enter and leave orbit. Since MEOs are not geostationary, they require more complex tracking and co-ordination than GEOs.

5.9 Low Earth Orbit Satellite (LEO's)

There are three generally accepted types of LEOs, namely little LEOs, big LEOs and broadband or super LEOs. They all operate some 400 to 1,600 miles above the earth. As a consequence there are negligible transmission delays between end users and satellites. The advantage of LEO technology is that its power requirements for signal transmission are relatively low, meaning that small handheld cellular type units can transmit signals to and from LEOs.

Forrester [29] says that low earth orbit satellites present valuable savings to the satellite-builder. Cell size on earth is determined by the size of the satellite antenna and the orbital height. The higher the altitude, the larger the antenna needed to achieve the same cell size. Thus a GEO would need a 17 -meter antenna, a LEO needs an antenna of only half a metre to service the same cell size.

Satellite battery-life also plays a major part in LEO, MEO and GEO mission planning. The Globalstar and Iridium LEOs, for example, orbit the earth in about 100 minutes consequently requiring 5,000 charge/discharge cycles each year for the onboard batteries. In GEO orbit the batteries could be expected to last around 15 years easily, but this figure drops markedly in low earth orbit, with life expectancies of only about eight years.

5.10 Iridium

Iridium is one of the satellite companies that South Africa uses for its satellite infrastructure.

Iridium [30] says that it has 66 satellites forming a cross-linked grid above the earth. The Iridium system is the first low earth orbiting system for wireless telephone service. Only 780 km (485 miles) high these satellites work differently from those in higher orbit (36,000 km) in two major ways. Firstly they are close enough to receive the signals of a handheld device and secondly they act like cellular towers in the sky, where wireless signals move overhead instead of through ground based cells.

Iridium [30] says that it has gateways that are located in key regions around the world. Iridium gateways interconnect the Iridium constellation with Public Switched Telephone Networks, making communications possible between Iridium phones and any other telephone in the world. Gateways are owned and operated by Iridium LCC investors.

5.10.1 Iridium Services

Iridium provides telephony and paging coverage virtually anywhere in the world. Iridium world satellite services provide a direct satellite link for both incoming and outgoing communications in remote areas, poorly covered regions and location outside terrestrial networks.

Iridium world roaming service facilitates roaming across multiple wireless protocols, allowing a subscriber to keep one telephone number and receive one telephone bill for calls made anywhere on earth.

5.10.2 Communications Frequencies

The Iridium system employs a combination of Frequency Division Multiple Access and Time Division Multiple Access (FDMA/TDMA) signals, multiplexing to make the most efficient use of a limited spectrum.

The L-band (1616-1616.5 MHz) serves as the link between the satellite and iridium subscriber equipment.

The Ka-Band (19.419.6 GHz for downlinks; 29.1-29.3 GHz for uplinks) serves as the link between the satellite and the gateways and earth terminals.

5.10.3 Iridium Offerings:

- Voicemail
- Call forwarding
- Call waiting (planned for 1999)
- Call barring
- Complete calling party pays
- Global notification services
- Emergency calling
- Enhanced call completion
- Short message system (pending)
- Conference calling (planned for 1999).

Iridium will use this technology in conjunction with MTN and Vodacom to ensure that South Africans have access to mobile telecommunications no matter where in the world they are.

MTN [31] says that the Iridium network is a wireless personal communications network designed to permit any type of telephone transmission - voice, data, fax, or paging - to reach its destination anywhere in the world.

The Iridium system is unique in that it carries a 'cross-link' feature that allows the satellites to communicate directly with one another, rather than having to reflect signals off strategically placed ground or earth stations. The Iridium 'cross link' feature reduces the number of earth satellite telephony networks. There are 12 terrestrial gateways stationed around the world and four control centres from which billing will be handled.

Another unique feature of Iridium is that it can 'talk' to any terrestrial network in the world. The user will have only one global telephone number, no matter what network system he/she is roaming on at that time. As a mobile cellular phone, it seeks out available service from existing land-based networks. In this way it operates the same as cellular systems now in existence.

5.10.4 Iridium World Satellite Mode and Inter-Satellite Links

When a cellular service is not available, the Iridium user can switch the phone to satellite operation. The network consists of 66 Iridium satellites, ensuring that there will always be one available to receive the transmission. The call is then relayed from satellite, until it reaches its destination, either through a local Iridium gateway and the public switched network or directly to a receiving Iridium phone.

5.10.5 Relaying Calls to Ground Based Networks

Iridium satellites keep track of the location of the user's telephone location anywhere on the globe. A signal bearing the telephones' unique identification number is relayed back to the user's home gateway operator. This provides the data necessary to process customer accounts as well as to interconnect with conventional phone systems.

S.A. Wireless Communications [32] reports that Iridium has been unable to obtain a licence from SATRA for the past three years, which makes it impossible for it to break into the South African satellite market. SATRA has submitted a proposed satellite service licence conditions document to the ministry of communications. SATRA stated in April 1999 that it was in the process of completing regulations for global mobile personal communication by satellite operators. A document is, reportedly, complete, but there is no confirmation of its date of publication.

Iridium believes there is a potential market in South Africa of about 100,000 subscribers, but as the company spokesman explained, "we can't undertake commercial activities here without a licence. We don't sell Iridium SIM cards in South Africa because we can't".

S.A. Wireless Communications [32] says that everything is in place for Iridium to start operating and working with MTN and Vodacom, making sure that users with dual-mode handsets roaming outside of cellular coverage can switch to satellite. This remains illegal, however, until the service is licensed.

It costs more to link up via MTN and Vodacom than to use the Iridium SIM cards. As soon as South Africans are able to take advantage of cheap satellite prices, the cost reductions will position Iridium as a competitive telecommunications service. If Iridium does not get a licence it is going to close shop in South Africa.

5.11 Globalstar

Globalstar is Iridium's competition as far as satellite services are concerned. Globalstar [33] says that while targeting the "international business person" with its big LEO designed for cellular/satellite telephony services, it is of the opinion that this market is smaller than is suggested by Iridium. Consequently, Globalstar also has a strategy for aggressively pursuing users who have no telephone service at all.

Globalstar is a satellite based, wireless telecommunications system designed to provide voice, data, fax, and messaging and other telecommunications services to users worldwide. Users of Globalstar will make or receive calls using hand-held or vehicle mounted terminals similar to today's cellular phones. Calls will be relayed through Globalstar's 48-satellite constellation, in a 1,414 kilometre (approximately 900 mile) orbit above the earth, to a ground station, and then through local terrestrial wireline and wireless systems to their end destinations.

5.11.1 Satellite Description

Globalstar [33] says that it uses simple low-cost satellites designed to minimise both construction and launch costs. Globalstar's satellites do not connect one Globalstar user directly to another. Rather, they relay communications between the user and a gateway. The party being called is connected with the gateway through the Public Switch Telephone Network (thus maximising the use of existing, low-cost communications services) or back through a satellite if the party is another Globalstar user.

Communications:

The heart of a Globalstar satellite is its communication system, which is mounted on the earth deck. The earth deck is the larger of the two rectangular faces on the satellite's body. There are C-band antennas for communications with gateways and L- and S-band antennas for communications with user terminals. These antennas are of a phased array design that projects a pattern of 16 spot beams onto earth's surface, covering a service area, or "footprint", of several thousand kilometres in diameter.

L-and S-band user links: 1610-1626.5 MHz (user to satellite)

2483.5-2500 MHz (satellite to user)

C-band feeder links: 5091-5250 MHz (gateway to satellite)

6875-7055 MHz (satellite to gateway)

Globalstar [33] says that the gateway is an integral part of the ground segment, which includes the gateways, Ground Operations Control Centres (GOCCs), Satellite Operations Control Centres (SOCCs) and the Globalstar Data Network.

The gateway interconnects the Globalstar satellite based wireless network and the Public Land Mobile Network (PLMN), such as global system for mobile communications (GSM), or directly with the local telephone office's -Public Switched Telephone Network (PSTN).

The gateway can be connected to the existing PSTN using standard E1/T1 trunk supporting a variety of signalling protocols. To GSM networks, the gateway appears as a GSM-based station subsystem. To those mobile switches in the EIA/TIA environment, it appears as another mobile switch supporting the IS-41 Intersystem Operation Standard. In all cases, inter-operability between Globalstar and telephone/cellular companies is assured, and the subscribers maintain a single convenient point for billing.

Globalstar [33] reports that it has designed its fixed station products to allow local content and subscriber flexibility. A Globalstar antenna radio unit and optional digital telephone is provided by Globalstar. This digital phone includes a display for call progress indicators and icons for voice mail memory of frequently called numbers. The in-country service provider can provide the subscriber equipment locally.

The Globalstar single fixed line pay phone unit connects a single pay phone into the Public Telephone Switching Networks (PSTN) and standard pay telephone service. Access to the Globalstar constellation is given by an antenna mounted outside the booth with a clear view of the sky. This antenna will be cabled into the booth and connected into the Code Division Multiple Access (CDMA) radio unit.

Globalstar [33] reports that for mobile subscribers a vehicle mounted car kit is available. The Globalstar handheld unit can be mounted in a cradle that provides power to extend battery life and a hands-free operation for convenience and driving safety.

Personal:

The Globalstar/GSM Dual-Mode User terminal offers a global roaming solution for GSM cellular phone users. Globalstar enhances wireless service options by providing worldwide GSM cellular-like services in areas outside traditional cellular coverage, inside the GSM cellular networks or by switching to the Globalstar network.

Globalstar [33] says its system is designed to complement and extend, not to replace, existing Public Switched Telephone Network (PSTN) and Public Land Mobile Network (PLMN) infrastructures.

A call made via a Globalstar User Terminal will first attempt to make a connection through existing local cellular infrastructure and failing that, via the Globalstar satellite system. The call is then relayed via satellite down to a gateway, which then routes it through the existing national PSTN/PLMN system to its destination.

Globalstar takes advantage of the worldwide expansion of fibre optics networks, which has allowed for significant advancements in call quality, capacity and efficiency. As a result it is expected that Globalstar's worldwide network of gateways and service providers, will be positioned to leverage off these improvements in the world's wireline/fibre optic networks. And at the same time, take advantage of the competitive pricing of the international tariffs as provided by exchange carriers to reduce costs for Globalstar users and service providers.

Globalstar and Vodacom have formed a partnership, which will enable Vodacom's subscribers to have access to telecommunications anywhere in the world.

Globalstar [34] says that Vodacom subscribers will enjoy blanket mobile telephone coverage by September 1999 through Vodacom&rsquo's service provider agreement with Globalstar Southern Africa (Pty.) Ltd. This is a result of the successful launch of a Globalstar satellite. It will now be easy for subscribers to use dual-mode phones capable of switching from conventional cellular telephony to satellite telephony automatically or by choice. Globalstar expects its satellite tariffs to be significantly cheaper than current available tariffs.

Mr Higson, Head of the Globalstar project office in South Africa said, "The phones will communicate through a Globalstar satellite to a ground station currently being constructed in Delareyville, Northwest Province. The ground station will connect calls to the existing terrestrial telecommunications network and should be completed before March 1999". Thirty-two satellites will be launched by Globalstar to enable commercial service by September 1999. By December 1999, a total of 52 satellites will be in orbit.

Vodacom and Globalstar go into business together with the stumbling block of South Africa's not having GMPSC licenses ready.

5.12 Trends of technologies and forecasts

5.12.1 Data Communications

Fitzgerald [35] says that data communications is the movement of encoded information from one point to another by means of electrical or optical transmission systems. Such systems are often called data communications networks. In general, these networks are established to collect data from remote points (usually terminals or microcomputers) and transmit data to a central point equipped with a computer or another terminal, or to perform the reverse process or some combination of the two. Data communication networks facilitate more efficient use of central computers and improve the day-to-day control of a business by providing faster information flow. They provide message-switching services to allow terminals to talk to one another. In general, they offer a better and more timely interchange of data among their users and bring the power of computers closer to more users. The objective of most data communication networks is to reduce the time and effort required performing various business tasks.

Their main functions are to:

- Capture business data at its source;
- Centralise control over business data;
- Effect rapid dissemination of information;
- Reduce current and future costs of doing business;
- Support business expansion at reasonable incremental cost as the organisation grows;

- Support organisation objectives in centralising or decentralising computer systems; and
- Support improved management control of the organisation.

Data communications can be used to tackle the following items in business settings:

- Widespread use of microcomputers;
- Decentralised operations;
- A high volume of mail;
- Messenger service usage;
- Numerous telephone calls between various sites (voice communications corridors, that is, telephone calls, may be replaced by data transfer corridors);
- Repetitive paperwork operations, such as re-creating or copying information;
- Inefficient and time-consuming retrieval of current business information;
- Slow and untimely handling of the organisation's business functions;
- Inadequate control of the organisation 's assets; and
- Inadequate planning and forecasting

The general public is increasingly using the Internet for data services and browsing. Corporate users are installing their own Intranets for information and staff is accessing all sorts of information. A lot of functionality is being developed for the public using data services. This will definitely spill over to mobile networks. It is evident that the Internet will be an important platform for delivering mobile data services.

Silver [36] says that data communications is a major domain of telecommunications. Data communications is the timely movement of alphabetic or numeric data in a system. That uses two discrete signal states, to transmit characters. This domain transmits words, phrases, textual matter or digital information between two or more points.

Silver [36] says that distinctions are not clear-cut and domains often overlap. Digital data (letters and numbers) can be transmitted over television and displayed on a screen. It can also be sent over voice-grade telephone lines. Today there are still businesses that specialises in selected areas of communications, such as the transmission of voice (telephone), pictures (television) and numbers and characters (computer terminals). It is still useful, however, to conceptualise information transferred into this area, because major facets of industry are built around it. Included in this industry is voice communication, which is telephone or radio. There is also video information. Pictures, images and diagrams sent over television or cable-access television system involves video transmission.

Rysavy [37] says that increasingly available and affordable wireless technologies like, cellular digital packet data (CDPD) and data-over personal communications services (PCS) do a fine job scuttling Internet Protocol (IP) packets, but real-world applications are more than the sum of their packets. Corporate networkers who want to put wireless Internet Protocol to work, need to clear certain hurdles, starting with limited coverage, low throughput and high latency.

Whether or not IP is worth it depends. The untethered technology can make a lot of sense in many business situations. Giving mobile workers access to corporate information and the Internet from anywhere can make them far more productive, but wireless Internet Protocol is not just another type of WAN connection. It has its own unique characteristics, ones that were not necessarily considered by developers of communications applications and networking protocols.

CCPD is the next option a digital packet overlay to the analogue cellular system that transmits Internet Protocol at an effective throughput of about 10kbit/s. Each mobile end-station has a fixed Internet Protocol address and is a true Internet host.

Rysavy [37] says one must consider the personal touch when discussing data. The technology that could tap wireless IP's true potential is data-over-digital personal communications services. Today's offerings are quite limited, restricted to circuit-switched connections to global system for mobile communications networks.

Personal communications services should increase in popularity as new services are rolled out. This year should see 14.4KBit/s Internet access for both global system for mobile communications and code division multiple access nets. Though still circuit switched these offerings will feel like packet thanks to the faster connections enabled by completely eliminating analogue modems. Beginning late 1999 CDMA, GSM and Interim Standard

136 (IS - 136) networks will all start offering high-speed packet data ranging from 64 to 384Kbit/s.

Rasavy [37] says faster wireless IP offerings are on the way. So-called 3G (third-generation) cellular systems will deliver throughput as high as 2Mbit/s in the local area and 144 kbit/s for mobile, but the earliest these systems will arrive in is 1999 and that's on a very limited basis. Most corporate networkers who want wireless Internet Protocol now are going to have to learn to live with 9.6 to 14.4 Kbit/s - a big consideration given that even 56-Kbit/s transfers can seem agonisingly slow on today's Internet.

They also have to deal with latency and its potentially crippling effect on client-server applications. With latencies (and round-trip times) ranging from half a second to more that five seconds, a new screen of information that takes a few seconds to update over a LAN could take half a minute or more over a wireless IP link.

Rasavy [37] says that wireless networks are linked to the rest of the world in three basic ways namely over private connections, over the Internet and over the public switched telephone network (PSTN). The third avenue of access, the switched public network is the least problematic for companies, since they already have dial-up systems in place for the remote users. If calls come in over a circuit, switched data service on a cellular network (via either an analogue or digital link) will be switched into the public switched telephone network and appear identical to other modem connections.

Many of today's cellular data services are, in fact, circuit switched. This will continue to be the case for the next few years, until wireless packet switched services start rolling out in Ernest. Network architects, who start getting ready now, are going to be in the right place to exploit new services and technologies.

Lippis [38] comments on moving mobile

Mobile Internet Protocol carriers on the wide area network (WAN) are already readying services, with good reason. The technology promises to deliver a lower cost of ownership and better quality than cellular. The interface is not whether the enterprise will be a standard leased line, with the carriers providing the infrastructure to support mobile users with IP routing.

The same goes for mobile Internet Protocol equipment. Vendors are rushing to implement the technology on all sorts of handheld, notably pagers, cell phones and palmtops.

Lippis [38] says that considering that plenty of net managers are going to build their own wireless infrastructure to support mobile IP on the campus or across the enterprise, it is an effective way to keep e-mail and data from competing with the general wireless population for limited bandwidth.

5.12.2 Asynchronous Transfer Mode

Dillion [39] says that Asynchronous Transfer Mode (ATM) is supposed to be all about scalability, i.e. from the departmental LAN (Local Area Network) to the global backbone. It is simply a matter of adding switches, but network architects run into many problems when they try to scale Asynchronous Transfer Mode to enterprise, because static routing, or setting up circuits by adding entries manually to the routing table of each Asynchronous Transfer Mode switch on the net.

The ATM Forum has a simple solution private network-to-network interface (PNNI), which dynamically updates switches on moves, additions and changes. Besides putting an end to repetitive-stress syndrome, the spec also enhances Asynchronous Transfer Mode's vaunted ability to deliver quality of service (QOS). Private network-to-network interface (PNNI) lets switches consider the bandwidth and delay of alternative paths, when deciding how best to meet the needs of any application. It also makes these judgements almost instantly, establishing the potential path or re-routing around problems far faster than frame-based protocols.

Dillion [39] says that peer group dynamics gives an explanation for networks. Private network-to-network interface (PNNI) simplifies the configuration of large networks, because it allows ATM switches to learn about their neighbour automatically and to distribute call routing information dynamically. Since asynchronous transfer mode is a connection-oriented service, there's a call set-up phase before data transfer begins.

Golick [40] says that the mention of multimedia to digital-age visionaries causes them to sing of data, graphics, audio and video coming together in a virtual reality whirligig of sight and sound.

Finding the storage capacity and bandwidth for a user' s transmitting a couple dozen 90-Mbyte video messages a week is however, a problem, and it will become worse with widening access to full duplex videoconferencing. Add to that intolerance to delay and jitters and multimedia looms not as the next big thing but as the next great challenge.

Gollick [40] says that, "data in various forms such as text, sound, still images, motion pictures and animation" is the innocuous-sounding definition of multimedia. Laid out in the Academic Press Dictionary of Science Technology, but that it means a lot more to net managers, who are forced to define it in terms of network traffic and new standards to support.

Golick [40] says that multimedia refers to data assembled prior to transmission, such as a pre-recorded speech. It is normally downloaded to the user's desktop before use, which makes it relatively insensitive to network delays. Raw throughput is the primary performance metric since the user cannot access the information until the entire file is received. The majority of multimedia traffic today, including strategic images, complex documents and recorded video, is pre-generated.

Real-time streaming, in contrast, refers to information created during transmission on the spot, such as a telephone call or live video feed. It is processed as a constant "stream" of incoming information and is highly sensitive to network latency. If the stream is delayed or interrupted, the end-user perceives a loss of quality or content.

E-mail storage requirements can be expected to increase by at least one order of magnitude in the near future and with more complex document types waiting to be created, storage requirements will grow at an exponential rate.

Gollick [40] says that asynchronous transmission mode allows two end-points to negotiate session parameters and specify such metrics as acceptable cell-loss rate, minimum throughput and maximum jitters and latency. The network, within the constraints of overall capacity, can adapt to the precise needs of different traffic types, but applications that take advantage of the services offered by asynchronous transmission mode are exceedingly rare. Although IBM and Microsoft are committed to building asynchronous transmission mode support into their operating systems, developments have been slow in coming (although asynchronous transmission mode interfaces are now available in Windows NT). For this reason it is difficult to consider asynchronous transmission mode a viable near-future solution for multimedia support.

GSMDATA [41] says there are barriers to growth in the mobile data industry. Mobile data has been slow to take off because of the limitations of available communications technologies. Many existing mobile standards are not designed with mobile data as a primary focus. Data functionality has been added belatedly to analogue cellular and private and public access mobile radio (PMR/PAMR). In some cases, core aspects of the technologies themselves - such as analogue transmission and cell-hand over in early cellular networks - have made them less than ideal medium for data transmission.

Even where technologies have been improved or specifically designed for data, some operators made the initial mistake of believing that the battle would easily be won. Early on in the field of dedicated mobile data, operators seemed to think that users would flock to new services. They did not. The lesson is that most users require applications, and not just at the platform. Only a very limited number of applications, generally with identifiable niches, have specific requirements which justify the time and cost of the development of the application-specific packages.

GSMDATA [41] says that the last factor is simply timing. When dedicated mobile operators launched their technology platforms, they were handicapped by the fact that appropriate software had not been developed. When manufacturers looked to communications to provide the "killer applications" for products in the early 1990s, they found that cellular manufacturers were simply not ready to support the push of mobile data. Mobile data applications will thus develop at the pace of the slow elements that comprise complete solutions.

One of the driving factors for mobiles is the short messaging service (SMS), which is increasingly being used for advanced features such as Internet-driven e-mail delivery. While wider support for mobile - originated SMS is bound to attract many users. GSMDATA [41] also points out that user trends and usage models will comprise of a new generation of mobile phones with data functionality built in, is currently being released, and positioned as direct terminals in their own right, but complementary to mobile PCs.

They are attracting enormous interest, with demand exceeding supply in the early weeks of sale.

GSMDATA [41] says that future developments include the positive acceptance of the concept by business, the explosion of e-mail and Internet services, the low penetration of mobile data into the fast-growing installation of portable computing devices. And the enormous importance of data in fixed business communications and a genuine need for such services.

GSMDATA [41] says that if we look around at the penetration of digital cellular technologies that are capable of supporting support services. It is clear that the conditions for the mobile data revolution to finally take hold exist in Europe, they will develop elsewhere as the GSM community grows across the globe.

According to GSMDATA [41], there are factors, which could limit growth. Mobile data communications must be perceived to be reasonably priced. It is tempting for operators to position data as a premium service by setting tariffs too high, which may delay take-up in the short term, while increased competition leaves those who adopt this policy with fewer customers. One difficulty which operators have to overcome is the fact that while subsidies have made street prices for handsets very low, there is little scope for subsidising data-cards, often making them appear more expensive than the phones themselves. GSMDATA [41] believes that promoting faster uptake through lower tariffs will help to bring down the price of data cards naturally.

Infrastructure vendors like Ericsson, Nokia and Motorola, are keen to sell packet data upgrades, but also to ensure that there will be end-to-end connectivity to the Internet. They are doing their utmost in putting together standard forums, which will help the movement towards packet data packages as wireless access protocol (WAP). Bluetooth technology is another example of vendor-driven technology. Again, it has been driven by the likes of Ericsson and Nokia, to simplify the whole process of users and operators.

In terms of operators, a lot of cultural elements will have to be looked at. Mobile operators are not familiar with IP and the Internet. With mobile data, the network will host a pipeline to move the actual data. It will be advantageous for operators, and mobile operators to embrace full partnership in order to do justice to this service, using simple bundled packages, with all software integrated onto, the terminal with the PC card integrated into the terminal.

5.13 Future Developments in the Mobile Industry

Observing the trends and future developments in the mobile industry, experts have something to say about what will happen in the future. Corpteros [42] says that the mutation of IT and telecommunications infrastructure into one intertwined data transfer methodology, is embodied in a new buzzword, "convergence". At the heart of convergence lies multi-functionality and the ability to sustain various protocols, including voice, Internet traffic, digital file transfer, fax and video-conferencing, on the same communications signal.

This necessitates high data-rate communication services, support for packet and circuit switched services, large volume capacity and sustenance of numerous simultaneous connections.

Multi-functionality allows users to browse the Internet, make a phone call and receive a fax at the same time. Without the required bandwidth this would all be impossible. Bandwidth, very simply, is the volume and speed capacity of the telecommunications connection. The optimal use of available bandwidth appeared in the way computers transfer data between each other: what it means, is that one is always online with the host application, without occupying a dedicated channel. Bursts of information are thus transferred when the required capacity is available. If we view voice as just another form of digital data, then packet switching in a converged environment becomes a reality.

Land-based telecommunications technology, such as integrated services digital network (ISDN), is tackling the issue of convergence and the required bandwidth with great energy, but it is the need for absolute mobility that it drives the development of wireless multimedia capabilities, which are currently being pioneered by Ericsson.

Market research has shown an indispensable parallel growth between the use of the Internet and mobile phones. Remote access now begins to mean exactly that, regardless of the availability of physical telephone lines.

Ericsson's ability to meet the demand of wireless multimedia services was demonstrated with by the development of High Speed Circuit Switched Data (HSCSD) and General Packet Radio Service (GPRS) capabilities. GPRS is packet switched mobile data service that has been widely accepted as the next step in the development of GSM technology. By the year 2000, GSM will have evolved with GPRS multi-slot capability and 14.4Kbps per timeslot, facilitating effective data rates of up to 115Kpbs.

The secret behind general packet radio service (GPRS) is that it optimises use of the available bandwidth, especially for intermittent bursts of Internet and Intranet traffic, by using radio resources only when actually receiving or transmitting data, thus allowing for many users to share the same channel. Efficient and effective use of various end-user applications, such as e-mail and Internet browsing is ensured.

The Wireless Application Protocol has become the world standard to which wireless information and telephony services on digital mobile phones must subscribe. Handset manufacturers, representing over 75% of the market across all technologies, have a user group to develop agreed protocols for uniform interfaces.

All WAP applications will function across a variety of networks. They will include various services and be compatible with a host of devices, from mobile phones and palmtops, to laptops and Personal Digital Assistants (PDA). Current practices dictate that if mobile phone users want access to online services, they have to connect their computers to the mobile phones. With WAP-enabled terminals, the terminal itself has a built-in browser. Internet access from small screen mobile phones will finally put the world in your pocket.

Corpteros [42] says Ericsson WAP Gateway is a network node providing a direct connection between the communication network and the Internet application servers. It acts as a client of these servers, accessing them via circuit or packet-switched systems and should be available from mid-1999.

Corpteros [42] says that by 2002, the third generation will be upon us. Currently under development, this system will be compatible with second generation systems, such as GSM, and will offer new breakthrough user benefits such as advanced Multimedia service, and next generation mobile Internet. Today there is worldwide support to base the third-generation system on a technology that Ericsson has called as Wideband Code Division Multiple Access (WCDMA). It offers a full suite of multimedia applications at minimal cost. Apart from the enhanced ability of current multimedia applications, such as video conferencing, WCDMA opens the door to specialised mobile multimedia, including remote security monitoring, vehicle navigation systems and interactive health applications.

Quinley [43] says that for network operators in developing regions, buying into GSM could prove to be a smart investment decision, given recent developments in the technology's upgrade path. Several major enhancements that could effectively future proof services for customers are starting to receive much attention, most notably General Packet Radio Services and Enhanced Data Rate for GSM Evolution (EDGE). The International Telecommunications Union knows the ultimate leap to wideband wireless in the form of Universal Mobile Telecommunications System (UMTS) or IMT-2000 as it is.

Access to telecommunications has been and will remain at the core of economic development in the emerging markets. In order to reach out into the future and expand upon the significant progress that has been made over a short timeframe, third generation wireless access in these economies is especially vital.

Quinley [43] says that rolling out third generation wireless networks and services is a tradition, which is equally salient for swift introduction into the developing economy. It can facilitate not only economic growth, but also valuable societal integration. New regions, of the developing world as diverse as sub-Sahara Africa, Latin America and the Middle East are all set to become net beneficiaries of the late second-generation wireless. Furthermore, a major incentive for developing regions and remote locations is the role of the global satellite mobile networks now in the throes of commercial launch.

Third generation wireless will be able to harness the power of new access technologies and bearers, such as the Internet, for education and information purposes in the schools, and access centres in more remote areas, such as Australia's outback, the Himalayas, or half-way up the Amazon river.

According to Quinley [43], commercially, implementing third generation wireless in developing regions makes good business sense too. Opening up a retail market for e-commerce to remote regions can augment over-populated and fiercely contested mature markets. In marketing there will always be tiers of demand for low cost stretching across to high-spec goods and services.

One of the things that this industry has been striving for has been universality of the wireless family of technologies. It is time to grasp the opportunity of plummeting producer-prices and branch out into the whole world. Convergence of not only fixed and mobile telecommunications, telecommunications and information, but also economies and mindset, makes for systems that need to be transparent and open to equal access in time honoured tradition. No information 'haves' and 'have-nots' should not be allowed to develop in this new age of wireless access, irrespective of location, politics, or social status. On the road to integration there are countries in different states of deregulated telecom markets, which, to a greater or lesser extent, can be facilitate the opening up of domestic markets. By promoting competition and allowing access to third generation wireless operators, may enter some markets for the first time.

Quinley [43] says that regional economies around the world are ever more inextricably linked. Financially, commodity and retail markets prosper through cohesive and pragmatic approaches to system networking - of all kinds. It is generally recognised that telecommunications of all forms, is the nervous system of economic activity the world over. Leaving out any one part surely defeats the object and threatens to undermine the rest of the hard work. Far be it for the wireless industry to be the conscience of a new world order, but if the remit of the industry then it has to be this, get the world rewired wirelessly.

One key goal for third generation mobile services is the establishment of global roaming capabilities. This will bring significant societal benefits to increasingly mobile and itinerant people in the next century. For government institutions in emerging markets, the radio spectrum available for global societal growth and integration, will be a key issue over the coming years. A family of systems for the third - generation wireless called IMT-2000 will require access to appropriate and adequate radio spectrum to meet expected demand.

Haller [44] says that technology now moves at space-shuttle speed. The cellular industry is one of the most exciting industries today, but at the same time one of the most daunting. We got used to holding cell phones to our ears to communicate, but now we are being told to hold our cell phones in our hand in order to communicate visually. Nokia says that we are moving from a hear phone to a view phone and the last time something similar occurred, was during the move from radio to television.

Communications today is looks at building blocks being developed on which the future of cellular communications will rest. From WEB to wireless application protocol - the platform for a new generation of cellular phones. Phones are becoming personal multimedia tools.

According to Haller [44], WAP will bring the Internet to the palm of your hand and Nokia has captured the initial market with the development of the world's first WAP phone, the 7110. WAP is a universal open standard for bringing Internet content and advanced Value Added Services to cell phones and other wireless devices. New media telephones will make this promise a reality with expertly developed user interfaces, larger screens, more memory and easier input allowing better connectivity.

The main reasons why this technology will succeed is the popularity of the Internet and the fact that Internet companies are just as eager to get into the cell phone market. This is essential, because Web pages have to be modified before wireless customers can download them onto their much smaller phone screens.

Services, which are most obviously WAP-compatible, are banking, weather reports, flight information, ticket sales, traffic reports and CNN headlines. Their problem is that media phones cannot support full-colour visuals and large graphics yet.

"Seamless Connectivity Bluetooth" is a short-range radio based technology developed by the Bluetooth Special Interest Group (SIG) consisting of Ericsson, IBM, Nokia, and Toshiba. It is designed to link portable devices such as cell phones, portable PCs, personal digital assistants (PDA's), printers and digital cameras so that they can exchange data without the use of cable, which hampers ease-of use.

Bluetooth is a technology-enabling advanced interconnectivity between different electronic devices through a short-range radio link (Low Power Radio Frequency or LPRF). Imagine taking a business trip and instead of carrying along a laptop, taking a Bluetooth-enabled portable hard drive. Haller [44] says that this device is small enough to fit into one's pocket and whenever one is in the range of a computer with Bluetooth capability, one can access all one's files and save new files onto one's drive, from that computer.

Other Bluetooth developments include "Bluetooth Info-Wear", which is a personal digital assistant (PDA) in the form of a wristwatch! This device can access information contained within the user's Bluetooth enabled computer, such as the address-book, calendar, tasks and e-mail. The watch has four operations, which enable the functions to read e-mails, accept reject meetings, mark tasks completed and pre-set automatic replies to e-mails. The info-wear watch automatically synchronises and updates the PC as soon as it comes into range.

Another accessory is the "wireless wallet", which provides an easy and efficient way to access any Smartcard-based services. Only 17mm thick when closed, it is an ordinary looking leather wallet, yet it contains the magic of Bluetooth connectivity.

Haller [44] says furthermore, that some cell phone developers are looking at the option to integrating a large proportion of the Bluetooth silicon chip into the existing chipset, which is the technical heart of the cell phone.

Third Generation (3G) mobile devices and services will transform wireless communications into, real-time on-line connectivity, regardless of time and place. We can constantly be linked to several location-based services that offer us the particular kinds of information that we need. Third Generation (3G) systems is the umbrella term given to the new range of infrastructure and handsets being developed to provide much enhanced data communication services within cellular networks.

Haller [44] says that these services, which will provide data rates from 384 KBps up to 2 MBps, are scheduled to begin in the year 2000, with the high-speed Universal Mobile Telecommunications System (UMTS), becoming available during 2002. Human needs evolve and the need for instant information at any time and any place is becoming stronger. There are a few concepts, which are steering future communications technology. There is the convergence of Internet and cellular, followed by the development of technologies to support it. The result will be a plethora of new concepts.

In conclusion, this chapter gives us a feel of the present technologies and new technologies to come into play in the cellular industry. It even gives us an insight into which direction the cellular industry will be taken in the future, e.g. moving us away from the hear phone to the view phone and also moving us away from cable connectivity to Bluetooth technology.